TECHNICAL MANUAL

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OPERATOR'S, ORGANIZATIONAL, DIRECT

SUPPORT AND GENERAL SUPPORT

MAINTENANCE MANUAL

REL RECEIVER GROUPS CONSISTING OF RECEIVERS TYPE 1130 AND 1130A RF PRESELECTOR TYPE S-1997, AND TUNNEL DIODE AMPLIFIER TYPE 1133

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HEADQUARTERS, DEPARTMENT OF THE ARMY
OCTOBER 1971

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TECHNICAL MANUAL

No. 11-5820-794-14

HEADQUARTERS

DEPARTMENT OF THE ARMY

WASHINGTON, D.C., 13 October 1971

OPERATOR, ORGANIZATIONAL, DIRECT AND GENERAL SUPPORT MAINTENANCE MANUAL

REL RECEIVER GROUPS CONSISTING OF RECEIVERS TYPES 1130 AND 1130A, RF PRESELECTOR TYPE S-1997, AND TUNNEL DIODE AMPLIFIER TYPE 1133

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* This technical manual is an authentication of the manufacturer's commercial literature and does not conform with the format and content specified in AR 310-3, Military Publications. This technical manual does, however, contain available information that is essential to the operation and maintenance of the equipment.

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I. INTRODUCTION

A-1. SCOPE

This manual describes the RF Preselector, Tunnel Diode Amplifier, and Receiver, also referred to as the Receiving Equipment. It covers their installation, operation, and organizational, direct and general support maintenance.

A-2. INDEXES OF EQUIPMENT PUBLICATIONS

a. DA Pam 310-4. Refer to the latest issue of DA Pam 310-4 to determine whether there are new editions, changes, or additional publications pertaining to the equipment.

b. DA Pam 310-7. Refer to DA Pam 310-7 to determine whether there are modification work orders (MWO's) pertaining to the equipment.

A-3. FORMS AND RECORDS

a. Reports of Maintenance and Unsatisfactory Equipment. Use equipment forms and records in accordance with instructions given in TM 38-750.

b. Report of Packaging and Handling Deficiences. Fill out and forward DD Form 6 (Report of Packaging and Handling Deficiences) as prescribed in AR 700-58 (Army)/NAVSUP Publication 378 (Navy)/AFR 71-4 (Air Force)/and MCO P4030.29 (Marine Corps).

c. Discrepancy in Shipment Reort (DISREP) (SF361). Fill out and forward Discrepancy in Shipment Report (DISREP) (SF361) as prescribed in AR 55-38 (Army)/NAVSUP Publication 359 (Navy)/AFM 75-34 (Air Force)/and MCO P4610.19 (Marine Corps).

d. Reporting of Equipment Manual Improvements. Report of errors, omissions, and recommendations for improving this publication by the individual user is encouraged. Reports should be submitted on DA Form 2028 (Recommended Changes to DA Publications) and forwarded direct to Commanding General, U.S.Army Electronics Command, ATTN: AMSEL-ME-NMP-EM, Fort Monmouth, N.J. 07703.

B. PURPOSE

The Receiving Equipment provides a means of amplifying and detecting a frequency-modulated carrier assigned in the 1.7 to 2.4 gc band. It is used in two-way multichannel communications networks in the line-of-sight, diffraction, or tropo-scatter modes of operation. In addition, it may be used singly, or its output may be combined with Receivers of other groups for diversity operation. The Receiver is capable of Radio Terminal operation with Frequency-Division, Time-Division, or Pulse-Code Multiplex equipment, and it is also capable of operation as a Repeater in a Radio Relay Link.

C. DESCRIPTION

1. Receiving Equipment

The Receiving Equipment is part of the REL 2600-Series of Equipment. It consists of an RF Preselector, a Tunnel Diode Amplifier, and a basic Receiver mounted in a standard 19-inch Equipment Rack. The Equipment Rack is capable of mounting two Receivers, two RF Preselectors and two Tunnel Diode Amplifiers.

2. RF Preselector

Selectivity for the Receiving Equipment is obtained by using an RF Preselector. The RF Preselector is a passive-type, multicavity, bandpass filter that is tunable to an assigned frequency in the 1.7 to 2.4 gc band. The RF Preselector is tuned to accept with a minimum insertion loss, the assigned carrier frequency, and to reject all other frequencies.

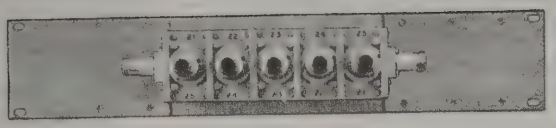
3. Tunnel Diode Amplifier

RF Amplification is provided by the Tunnel Diode Amplifier (TDA). The TDA is a self-contained unit with a built-in bias network designed to operate from +12 volts dc which is derived from the Receiver system power supply. Thermostatic sensors control the heating current to maintain a constant temperature in the TDA; thus, insuring electrical stability. The Tunnel Diode Amplifier is a low noise reflection-type amplifier, using the negative resistance characteristics of the tunnel diode, and operates in the RF range of 1.7 to 2.4 gc. The amplifier gain is 17 ±2 db. When followed by a 9.0 db noise figure Receiver (i.e., without TDA), an overall Receiver noise figure (with TDA) of 4.5 db (maximum) is realized.

4. Receiver

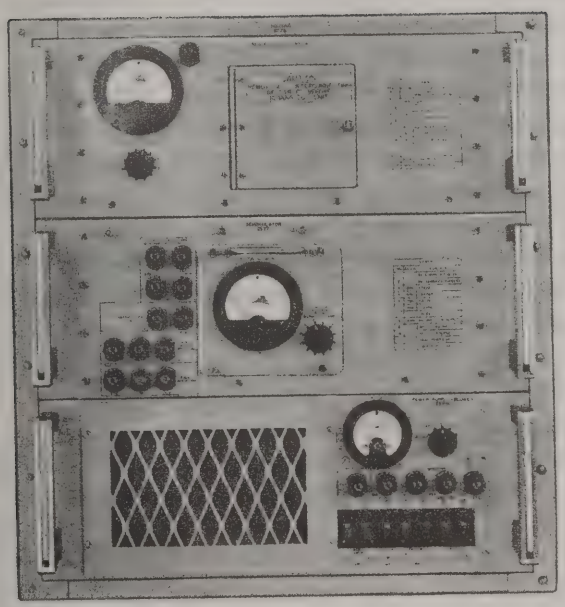
The Receiver is a solid state, superheterodyne unit, consisting of a Frequency Converter, a Demodulator, and a Power Supply-Blower. The drawer assemblies of the Receiver are contained in a housing suitable for rack mounting. Channel capacity options from 12 to 300 may be obtained by the simple interchange of modules and printed-circuit cards in the Demodulator. The 70-mc IF is standard throughout all REL 2600-Series Equipment, and only the Frequency Converter need be replaced to change to any frequency band between 350 and 8500 mc.

The input signal to the Receiver is heterodyned, in the low-noise Mixer of the Frequency Converter unit, with the oscillator injection signal to obtain a 70-mc IF output. The local oscillator signal originates from the crystal-controlled Oscillator-Doubler, and is then frequency multiplied by the Step-Recover Diode (SRD) Multiplier. An IF delay line may be used to connect the output of the Frequency Converter to the Demodulator in order to compensate for the different lengths of transmission lines (from the Antennas to their respective Receivers) in a diversity system.



S-1997
RF
PRESELECTOR

TYPE 1133
TUNNEL DIODE
AMPLIFIER



FREQUENCY
CONVERTER

DEMODULATOR

POWER
SUPPLY-BLOWER

TYPE 1130
RECEIVER

Figure 1-1. Receiving Equipment

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In the Demodulator, the 70-mc IF signal is amplified, amplitude-limited, and then passed through the Discriminator to obtain the original traffic inputs contained within the baseband range. Each basic Receiver employs a high performance, maximal-ratio, post-detection Combiner. When Receivers are used in a diversity system, they are interconnected so that the demodulated outputs are combined. The Combiners effect an overall improvement in the Receiver signal-to-noise ratio.

The automatic Threshold-Extension Demodulator improves the sensitivity of the Receiver under weak signal conditions. When operative, this Demodulator converts the Receiver into a double superheterodyne type, possessing a 30.5-mc second IF circuit of restricted bandwidth. This circuitry is optional on Receiver 1130A.

The Receiver consists of lightweight, modular plug-in units, utilizing printed-circuit cards throughout. Slide-out equipment drawers, front-panel meters, and test points are available to facilitate maintenance and repair. All operating controls are on the front panels. Built-in test points and maintenance controls are easily accessible when the drawers are open. Fault lamps are provided on the front panels to indicate malfunctions and the operating status of the equipment.

5. System Applications

The Receiving Equipment may be used in a number of configurations for microwave LOS, troposcatter, long-range telemetry, or space communications systems. The basic system consists of one Transmitter and one Receiver. In troposcatter transmission, losses depend primarily upon the distance between terminals, scattering angle, and frequency. In addition, reception is subject to several types of fading. Fading may be overcome or minimized by use of diversity reception and high-gain antennas. In diversity reception, a choice of signals is made from information received along different transmission systems. This may be accomplished by individual use of space diversity or frequency diversity, or a combination of both. Ultimately, each signal received contributes to the final output signal in the Receiver by a method of combining which offers a signal-to-noise ratio more favorable than that of the strongest signal alone.

Space diversity occurs when two antennas are placed at more than 100 wavelengths apart. Receive signals, generally will not fade simultaneously at both antennas. Frequency diversity occurs when an antenna receives signals on different frequencies within the same band. The received signals on two frequencies at a given location generally will not fade simultaneously in the two Receivers. Quadruple diversity systems, using four Receivers, and employing a combination of dual space, dual frequency transmission are common applications providing a high degree of reliability. In addition to redundancy in propagation paths, there is signal-path redundancy in the event of equipment failure.

D. SPECIFICATIONS

Leading particulars and parameters applicable to the RF Preselector, Tunnel Diode Amplifier and Receiver are provided in the Table of Specifications.

TABLE OF SPECIFICATIONS

Particular	Parameter
RF PRESELECTOR	
Frequency Range	1700 to 2400 mc
Insertion Loss at f_o	0.8 db maximum
Stop-Band Rejection	70 db minimum (f_o ±60 mc) 78 db minimum (f_o ±70 mc) 100 db minimum (f_o ±140 mc)
Impedance:	
Input	50Ω nominal
Output	50Ω nominal
VSWR	1.2:1 maximum (f_o ±4 mc)
Bandwidth:	
-3 db	±7.5 mc minimum, ±11.5 mc maximum
-70 db	±55 mc maximum
Dimensions:	
Depth	6-1/4 inches
Height	3-1/2 inches
Width	19 inches
Weight	7 pounds
TUNNEL DIODE AMPLIFIER	
Frequency Range	1700 to 2400 mc
Noise Figure	4.5 db (including a second stage noise figure of 9 db)
Diode Type	Gallium antimonide
Bandwidth*	200 mc minimum (across frequency range)

*Note: Each TDA contains a Ferrite Circulator and Tunnel Diode Module that has been factory assembled and adjusted for a particular 200 mc usable bandwidth within the 1.7 to 2.4 gc frequency range.

TABLE OF SPECIFICATIONS (Cont)

Particular	Parameter
TUNNEL DIODE AMPLIFIER (Cont)	
Gain	17 db ±2 db
Frequency Response	Less than ±0.25 db across 20 mc band
Gain Compression	1 db at -40 dbm input
Impedance (across operating bandwidth)	
Input	50 ohm nominal, VSWR 1.2:1
Output	50 ohm nominal, VSWR 1.2:1
Temperature Range:	
Operating	0°C (+32°F) to +45°C (+113°F)
Storage	-65°C (-85°F) to +71°C (+160°F)
Primary AC Voltage Required	120 volts ±5%, 47 to 63 cps, single phase, 2 wire
Bias Voltage	-1.4 volts dc 0.05% regulation 4 millivolts ripple
Dimensions:	
Depth	12 inches
Height	3-1/2 inches
Width	19 inches
Weight	11 lbs
TYPE 1130 RECEIVER	
RF Range	1700 to 2400 mc
Operating Frequency	Tunable to any frequency in specified RF range by means of single quartz crystal (one for each frequency)

TABLE OF SPECIFICATIONS (Cont)

Particular	Parameter
TYPE 1130 RECEIVER (Cont)	
Frequency Stability	±0.0005% from 0°C (+32°F) to 45°C (+113°F) ±0.002% from -20°C (-1°F) to +54°C (+130°F)
Noise Figure	4.5 db nominal with TDA 9 db nominal without TDA
Input Impedance	50Ω
Input VSWR	1.2:1 at f_c ±5 mc
Overall Bandwidth	
72 Channels (Normal Threshold)	3 mc ±10%
72 Channels (Threshold Extended)	0.75 mc nominal
132 Channels (Normal Threshold)	6 mc ±10%
132 Channels (Threshold Extended)	1.0 mc nominal
Receiver Threshold (including TDA):	
72 Channels (Normal)	-92 dbm minimum
72 Channels (Extended)	-96 dbm minimum
132 Channels (Normal)	-89 dbm minimum
132 Channels (Extended)	-94 dbm minimum
Peak Complex Deviation (Based on CCIR Loading and 13 db Noise Crest Factor):	
72 Channels	±924 kc peak complex (±100 kc RMS test tone)
132 Channels	±1050 kc peak complex (±100 kc RMS test tone)
VF Channel Capacity	72 or 132
Baseband Frequency Range	72 Channels: 12 to 300 kc 132 Channels: 12 to 552 kc

TABLE OF SPECIFICATIONS (Cont)

Particular	Parameter
TYPE 1130 RECEIVER (Cont)	
Intermediate Frequency	70 mc
Radio Pilot Frequency	60 kc
Order Wire Frequency Range	250 cps to 12 kc
Impedance	Baseband 75Ω unbalanced Order Wire 600Ω balanced
Test Tone Output Levels	Baseband -15 dbm (-45 dbm Exciter Input) Order Wire -15 dbm (-30 dbm Exciter Input)
Baseband Level Adjustment	Output variable from -19 to -11 dbm, in 1-db steps
Radio Pilot Deviation	10 db below test tone
Test Tone Deviation	72 and 132 Channels: 100 kc rms
Overall Frequency Response (Including Exciter and Power Amplifier)	Baseband: ±0.25 db (maximum) change, over each 250 kc range Order Wire: +1 to -2 db or better in relevance 1 kc from 250 cps to 12 kc
Intermodulation Distortion (Including Exciter and Power Amplifier)	-55 db NPR (Normal threshold) by noise loading -35 db NPR (extended threshold) by noise loading
Deemphasis	72 Channels: 1.1 μsec 132 Channels: 0.6 μsec
Residual Noise	Better than 72 db below test tone in a 4-kc bandwidth above 12 kc
Type of Combining	Postdetection. Optimum ratio baseband combining

TABLE OF SPECIFICATIONS (Cont)

Particular	Parameter
TYPE 1130 RECEIVER (Cont)	
Order of Combining	Dual or Quadruple
Combiner Response	1 millisecond (baseband) 100 milliseconds (order wire)
Combiner Recorder	For 1 ma, 1500Ω recorder. Nominally log-linear over 50 db range of received signal
Signal Strength Recorder	For 1 ma, 1500Ω recorder. Nominally log-linear over 50 db range of received range
Primary Voltage	120 volts ±10%, 47 to 63 cps single phase, 2 wire
Primary Power Consumption	280 va
Heat Dissipation to Air	950 btu/hr (approximately)
Power Interruption	When primary power is lost, the Receiver will be off. When power is restored, the Receiver comes back on immediately. No time delay is necessary and there is no need to reactivate circuit breakers.
Ambient Temperature:	
Operating	0°C (+32°F) to +45°C (+113°F)
Nonoperating	-65°C (-85°F) to +71°C (+160°F)
Barometric Pressure:	
Operating	5000 ft above sea level
Storage	40,000 ft above sea level
Dimensions:	
Depth	20-1/2 inches, including handles
Height	22-3/4 inches
Width	21 inches
Weight	175 pounds

TABLE OF SPECIFICATIONS (Cont)

Particular	Parameter
TYPE 1130A RECEIVER	
RF Range	1700 to 2400 mc
Operating Frequency	Tunable to any frequency in specified RF range by means of single quartz crystal (one for each frequency)
Frequency Stability	±0.0005% from 0°C (+32°F) to 45°C (+113°F) ±0.002% from -20°C (-1°F) to +54°C (+130°F)
Noise Figure	4.5 db nominal with TDA 9 db nominal without TDA
Input Impedance	50Ω
Input VSWR	1.2:1 at f_c ±5 mc
Overall Bandwidth	72 Channels: 3 mc ±10% 132 Channels: 6 mc ±10% 252 Channels: 10 mc ±10%
Receiver Threshold (including TDA)	72 Channels: -94.75 dbm (-92.0 dbm min) 132 Channels: -91.75 dbm (-89.0 dbm min) 252 Channels: -89.50 dbm (-86.5 dbm min)
Peak Complex Deviation (Based on CCIR Loading and 13 db Noise Crest Factor):	
72 Channels	±924 kc peak complex (±100 kc RMS test tone)
132 Channels	±1050 kc peak complex (±100 kc RMS test tone)
252 Channels	±2520 kc peak complex (±200 kc RMS test tone)

TABLE OF SPECIFICATIONS (Cont)

Particular	Parameter
TYPE 1130A RECEIVER (Cont)	
VF Channel Capacity	72, 132, or 252
Baseband Frequency Range	72 Channels: 12 to 300 kc 132 Channels: 12 to 552 kc 252 Channels: 12 to 1052 kc
Intermediate Frequency	70 mc
Radio Pilot Frequency	60 kc
Order Wire Frequency Range	250 cps to 12 kc
Impedance	Baseband 75Ω unbalanced Order Wire 600Ω balanced
Test Tone Output Levels	Baseband -15 dbm (-45 dbm Exciter Input) Order Wire -15 dbm (-30 dbm Exciter Input)
Baseband Level Adjustment	Output variable from -19 to -11 dbm, in 1-db steps
Radio Pilot Deviation	10 db below test tone
Test Tone Deviation	72 and 132 Channels: 100 kc rms 252 Channels: 200 kc rms
Overall Frequency Response (Including Exciter and Power Amplifier)	Baseband: ±0.25 db (maximum) change, over each 250 kc range Order Wire: +1 to -2 db or better in relevance 1 kc from 250 cps to 12 kc
Intermodulation Distortion (Including Exciter and Power Amplifier	-55 db NPR by noise loading
Deemphasis	72 Channels: 1.1 μsec 132 Channels: 0.6 μsec 252 Channels: 0.6 μsec

TABLE OF SPECIFICATIONS (Cont)

Particular	Parameter
TYPE 1130A RECEIVER (Cont)	
Residual Noise	Better than 72 db below test tone in a 4-kc bandwidth above 12 kc
Type of Combining	Postdetection. Optimum ratio baseband combining
Order of Combining	Dual or Quadruple
Combiner Response	1 millisecond (baseband) 100 milliseconds (order wire)
Combiner Recorder	For 1 ma, 1500Ω recorder. Nominally log-linear over 50 db range of received signal
Signal Strength Recorder	For 1 ma, 1500Ω recorder. Nominally log-linear over 50 db range of received range
Primary Voltage	120 volts ±10%, 47 to 63 cps single phase, 2 wire
Primary Power Consumption	280 va
Heat Dissipation to Air	950 btu/hr (approximately)
Power Interruption	When primary power is lost, the Receiver will be off. When power is restored, the Receiver comes back on immediately. No time delay is necessary and there is no need to reactivate circuit breakers.
Ambient Temperature:	
Operating	0°C (+32°F) to +45°C (+113°F)
Nonoperating	-65°C (-85°F) to +71°C (+160°F)
Barometric Pressure:	
Operating	5000 ft above sea level
Storage	40,000 ft above sea level

TABLE OF SPECIFICATIONS (Cont)

Particular	Parameter
TYPE 1130A RECEIVER (Cont)	
Dimensions: Depth Height Width Weight	 20-1/2 inches, including handles 22-3/4 inches 21 inches 175 pounds

E. ITEMS COMPRISING AN OPERABLE EQUIPMENT

FSN	ITEM	Quantity	Height (in)	Depth (in)	Width (in)	Weight (lb)
	RF Preselector S-1997	1	3-1/2	6-1/4	19	7
5820-179-8141	Tunnel Diode Amplifier 1133	1	3-1/2	12	19	11
5820-179-7879	Receiver 1130, consisting of:	1	22-3/4	20-1/2	21	175
5820-179-4404	Frequency Converter 24490	1				
5820-135-2517	Demodulator 22771	1				
6130-143-9927	Power Supply 22731	1				
5820-135-4691	Receiver 1130A, consisting of:	1	22-3/4	20-1/2	21	175
5820-179-7800	Frequency Converter 22761	1				
5820-135-2514	Demodulator 22772	1				
6130-143-9927	Power Supply 22731	1				

II. INSTALLATION AND OPERATION

A. INSTALLATION

Installation Drawings for the Receiver, RF Preselector and Tunnel Diode Amplifier are provided in this manual. Interface connections to other equipment should be specified on the Installation Drawings for the particular Site.

1. Installation of Equipment

Two RF Preselectors, two Tunnel Diode Amplifiers and two Receivers are mounted on the same Equipment Rack. All internal rack cabling is complete. The Equipment Rack must be secured in place and only the external connections have to be installed. Refer to the Site Drawings and the Installation Drawings when making the external connections to the equipment. The procedure is identical for all like equipment and they may be installed simultaneously.

a. Remove all Receiver Drawers to facilitate handling and to permit access to the terminal boards located on the inside of the Receiver Housing.

b. Secure the Equipment Racks in the position detailed on the Floor Plan for the site.

c. Insert the alarm, order wire, pilot interconnect, and recorder cables through the access slot provided on the right-hand side of the Receiver Housing and connect them to Terminal Boards TB2 and TB3.

d. Replace all drawers and connect the interdrawer cabling in accordance with the Receiver-Housing wiring diagram.

e. Connect the signal and monitor cables to the receptacles provided on the right-hand side of the Receiver Housing.

f. Connect the jumper cable, or an appropriate length of delay line, to 70-mc interconnections CP5 and CP6, on the right-hand side of the Receiver Housing.

g. Connect the AC power cable to Terminal Board TB1 in the AC Junction Box on the top of the Equipment Rack.

h. Connect the RF Input cable from the Antenna to RF INPUT connector J1 on the RF Preselector.

i. Open the RF Cable Access Door on the Frequency Converter and connect the RF Output cable from the Tunnel Diode Amplifier to RF INPUT connector J1.

j. Carefully inspect all work performed and recheck all connections with the Tables on the Installation Drawings.

2. Installation Testing

To determine that the equipment is operating satisfactorily, prior to placing it in service, proceed as follows:

a. Apply primary AC power and turn on the equipment (paragraph B-1).

b. Check the initial meter indications (paragraph B-2).

c. Complete all performance tests listed in the "Preventive Maintenance Schedule" (Section IV, paragraph B-2).

B. OPERATION

The operating procedures for the Tunnel Diode Amplifier and Receiver consist of a turn-on procedure, initial meter indications, switch settings, and a turn-off procedure. Location of the operating controls and indicators for the Tunnel Diode Amplifier and the Receiver are shown in figures 2-1 and 2-2 respectively. The index numbers on figures 2-1 and 2-2 are identified and the function of the control or indicator is provided in the Table of Controls and Indicators.

TABLE OF CONTROLS AND INDICATORS

Index No.	Name	Reference Designation	Function
TUNNEL DIODE AMPLIFIER (Figure 2-1)			
1	HEATER FUSE Indicator	DS2	Lamp goes on when Heater Fuse F1 blows.
2	HEATER INDICATOR	DS1	Lamp goes on when Thermal Switch S3 is closed and heating elements are on.
3	BIAS switch	S2	Applies Bias-Battery to Tunnel Diode Amplifier.
4	HEATER switch	S1	Applies 120-volt AC to Heater Circuit.

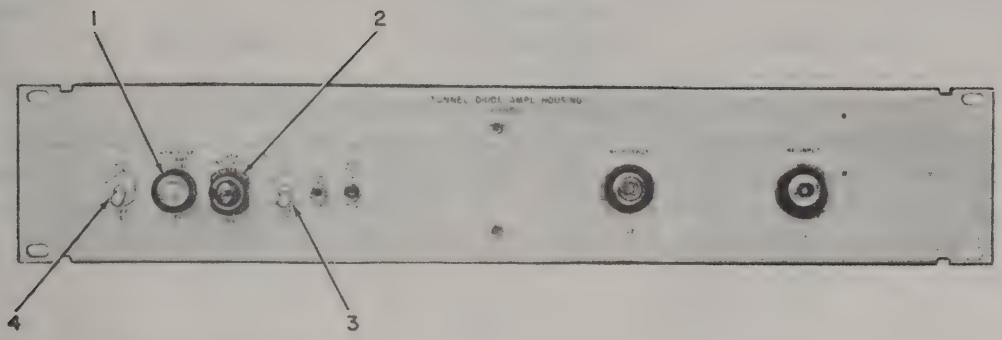

Figure 2-1. Tunnel Diode Amplifier, Controls and Indicators

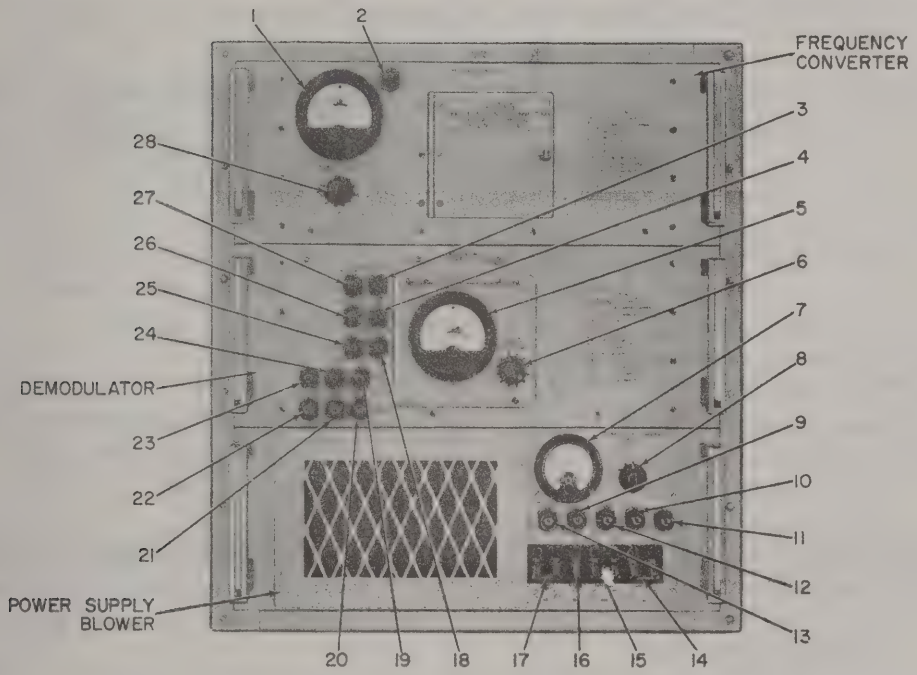

Figure 2-2. Receiver, Controls and Indicators

TABLE OF CONTROLS AND INDICATORS (Cont)

Index No.	Name	Reference Designation	Function
	FREQUENCY CONVERTER (Figure 2-2)		
1	STATUS INDICATOR	M1	Meter used in conjunction with Function Selector Switch S1 to indicate circuit levels and voltage supplies.
2	OVEN HEATER Indicator	DS1	Lamp goes on when Oscillator-Doubler oven is heating. After oven has reached normal temperature, lamp cycles on and off.
28	FUNCTION SELECTOR SWITCH	S1	Twelve-position rotary switch; selects the circuit or voltage supply to be indicated on meter M1.
	DEMODULATOR (Figure 2-2)		
3	RADIO PILOT DEFEAT	DS2	Lamp goes on when Radio Pilot switch S2 is set to defeat position.
4	COMBINER DEFEAT	DS4	Lamp goes on when Combiner switch S1 is set to defeat position.
5	STATUS INDICATOR	M1	Meter used in conjunction with Function Selector Switch S1 to indicate circuit levels and voltage supplies.
6	FUNCTION SELECTOR SWITCH	S1	Twelve-position rotary switch; selects the circuit or voltage supply to be indicated on meter M1.
18	RADIO PILOT FILTER OVEN HEATER INDICATOR	DS6	Lamp goes on when Radio Pilot Crystal Filter oven is heating. After oven has reached normal temperature, lamp cycles on and off.

TABLE OF CONTROLS AND INDICATORS (Cont)

Index No.	Name	Reference Designation	Function
DEMODULATOR (Cont) (Figure 2-2)			
19	DISCRIMINATOR OVEN HEATER INDICATOR	DS9	Lamp goes on when Driver-Discriminator oven is heating. After oven has reached normal temperature, lamp cycles on and off.
20	RADIO PILOT FAULT INDICATOR	DS12	Lamp associated with Pilot Amplifier; goes on when radio-pilot level drops 3 db or more.
21	NOISE AMPLIFIER PILOT FAULT INDICATOR	DS11	Lamp Goes on when Noise Amplifier Reflex and Recorder Amplifier becomes deactivated resulting in the Combiner output being removed from the diversity-connected Receiver.
22	BASEBAND FAULT INDICATOR	DS10	Lamp goes on when the baseband signal fails.
23	VCO OVEN HEATER INDICATOR	DS7	Lamp goes on when Voltage-Controlled Oscillator oven is heating. Not used in Type 1130A Receiver.
24	REFERENCE OSCILLATOR	DS8	Lamp goes on when Reference Oscillator oven is heating. Not used in Type 1130A Receiver.
25	THRESHOLD EXTENSION INDICATOR	DS5	Lamp goes on when Receiver is operating in the extended threshold mode. Not used in Type 1130A Receiver.
26	THRESHOLD EXTENSION DEFEAT INDICATOR	DS3	Lamp goes on when threshold Extension Defeat switch is set to DEFEAT. Not used in Type 1130A Receiver.
27	NOISE AMPLIFIER PILOT DEFEAT INDICATOR	DS1	Lamp goes on when Noise Amplifier switch S3 is set to defeat position.

TABLE OF CONTROLS AND INDICATORS (Cont)

Index No.	Name	Reference Designation	Function
POWER SUPPLY-BLOWER (Figure 2-2)			
7	STATUS INDICATOR	M1	DC Voltmeter used in conjunction with function selector switch S2 to indicate voltage supply output levels.
8	Function Selector switch S2	S2	Five-position rotary switch selects the output voltage supply to be indicated on meter M1.
9	BLOWER FAULT INDICATOR	DS2	Lamp goes on when circuit breaker CB1 trips, indicating a malfunction in the blower circuit.
10	-24V/-12V FAULT INDICATOR	DS4	Lamp goes on when circuit breaker CB4 trips, indicating a malfunction in the -24/-12 volt supply circuit.
11	OVENS FAULT INDICATOR	DS5	Lamp goes on when Fuse F1 blows, indicating a malfunction in the oven supply circuit.
12	+24V/+12V FAULT INDICATOR	DS3	Lamp goes on when circuit breaker CB3 trips, indicating a malfunction in the +24/+12 volt supply circuit.
13	MAIN POWER ON indicator	DS1	Lamp goes on when circuit breaker CB1 is on; indicating main power is supplied to the Power Supply-Blower.
14	-24V/-12V circuit breaker	CB4	Relay-trip circuit breaker; protects transformer T2 and controls application of 120-volt AC to -12/-24 Volt Regulator circuit.

TABLE OF CONTROLS AND INDICATORS (Cont)

Index No.	Name	Reference Designation	Function
POWER SUPPLY-BLOWER (Cont) (Figure 2-2)			
15	+24V/+12V circuit breaker	CB3	Relay-trip circuit breaker; protects transformer T1 and controls application of 120-volt AC to +24/+12 Volt Regulator circuit.
16	BLOWER circuit breaker	CB2	Relay-trip circuit breaker; protects and controls application of 120-volt AC to Blower.
17	MAIN POWER circuit breaker	CB1	Relay-trip circuit breaker; protects and controls application of 120-volt AC to Power Supply-Blower.

1. Turn-On Procedure

Prior to applying AC power to the equipment, turn off all power switches and circuit breakers. Apply primary AC power from the Main Power Source and then turn on the equipment as described in the Table for Turn-On Procedure.

TABLE FOR TURN-ON PROCEDURE

Item	Control	Position	Remarks
TUNNEL DIODE AMPLIFIER (Figure 2-1)			
1	HTR switch S1	ON	HTR INDICATOR lamp DS1 goes on. Allow 45-minute warmup period.
2	BIAS switch S2	ON	Unit is now ready for operation.
POWER SUPPLY-BLOWER (Figure 2-2)			
1	MAIN POWER circuit breaker CB1	ON	MAIN POWER ON lamp DS1 and BLOWER lamp DS2 go on.

TABLE FOR TURN-ON PROCEDURE (Cont)

Item	Control	Position	Remarks
POWER SUPPLY-BLOWER (Cont) (Figure 2-2)			
2	BLOWER circuit breaker CB2	ON	BLOWER lamp DS2 goes off. +24V/+12V lamp DS3 and -24V/-12V lamp DS4 go on.
3	+24V/+12V circuit breaker CB3	ON	+24V/+12V lamp DS3 goes off.
4	-24V/-12V circuit breaker CB4	ON	-24V/-12V lamp DS4 goes off.
NOTE: FAULT INDICATOR OVEN lamp DS5 will go on when Oven Supply Fuse F1 blows, indicating excessive oven supply current.			

2. Initial Meter Indications

To insure that the supply voltages are available, set the front-panel meter function selector switches to the positions specified in the following table and observe the meter indications. An initial installation warmup time of one hour is mandatory to permit equipment stabilization so that the required meter indications can be obtained. This warmup time is not required if the equipment has just been taken out of service.

TABLE OF METER INDICATIONS

Item	Switch Position	Function	Meter Indication
POWER SUPPLY-BLOWER			
1	24V (OVENS)	24 volt AC oven supply	Red Band
2	+24V	+24 volt regulated supply	Green Line
3	-24V	-24 volt regulated supply	Green Line
4	+12V	+12 volt regulated supply	Green Line
5	-12V	-12 volt regulated supply	Green Line

TABLE OF METER INDICATIONS (Cont)

Item	Switch Position	Function	Meter Indication
		FREQUENCY CONVERTER	
1	2	+24 volt regulated supply	Green Band
2	3	-24 volt regulated supply	Green Band
3	4	+12 volt regulated supply	Green Band
4	5	-12 volt regulated supply	Green Band
5	11	24 volt AC oven supply	Blue Band
		DEMODULATOR	
1	3	+24 volt regulated supply	Green Band
2	4	-24 volt regulated supply	Green Band
3	5	+12 volt regulated supply	Green Band
4	6	-12 volt regulated supply	Green Band

3. Switch Settings

Pull out the Demodulator Drawer and set the switches, listed in the Table of Demodulator Switch Settings, to the position indicating the desired type of Receiver operation. For normal operation of the Receiver, all switches are set in the NORM position. For other than normal operation, refer to the table.

TABLE OF DEMODULATOR SWITCH SETTINGS

Switch	Function	Type of Operation	Position
COMBINER S1	Selects either the single Receiver output or the output of the combined diversity Receivers.	Diversity Receiver Single Receiver	NORM* DEFEAT

*Make sure Pilot and Combiner Interconnect cables are connected between all Receivers.

TABLE OF DEMODULATOR SWITCH SETTINGS (Cont)

Switch	Function	Type of Operation	Position
RADIO PILOT S2	Allows Radio Pilot Circuit to function, or disables Radio Pilot Circuit.	Normal radio pilot	NORM
		No radio pilot tone from Transmitter	DEFEAT
NOISE AMPL PILOT S3	Bypasses the Noise Amplifier Reflex Circuit, preventing the Combiner from removing the Receiver from the line when the radio pilot tone is not present.	Normal radio pilot	NORM
		No radio pilot tone from Transmitter	DEFEAT
BB OUTPUT ATTENUATOR	Allows the normal baseband output level to be temporarily changed ±4 db in 1 db steps.	For normal system operation	NORM
		For other than normal system operation	As required
THRESHOLD EXT S4	Allows threshold extension to function normally, to be tested or to be defeated. Not used in type 1130A receiver.	For wideband Receiver operation	DEFEAT
		For test purposes	TEST
		For normal system operation	NORM

4. Turn-Off Procedure

a. On the Tunnel Diode Amplifier, set BIAS switch S2 and HTR switch S1 to OFF.

NOTE: If HTR switch S1 is turned OFF for an extended period a warm-up time of 45 minutes is necessary for heat-sensitive components to stabilize.

*CAUTION: To protect the diodes in the Pilot Amplifier, disconnect the Pilot Interlock cable from Pilot Reflex connector CP3 before turning off the Power Supply-Blower.

*ECN No. 15212 should be installed which prevents this problem.

b. On the Power Supply-Blower, set circuit breakers CB4, CB3, CB2, and CB1 to OFF.

NOTE: If circuit breaker CB1 is turned off for an extended period, a warm-up time of one hour is required for the heat-sensitive components to stabilize.

III. FUNCTIONAL DESCRIPTION

A. GENERAL

The overall receiving equipment consists of a RF Preselector, a Tunnel Diode Amplifier, and a Receiver (figure 3-1). The equipment is capable of being tuned to receive wideband, frequency modulated signals in the RF range of 1.7 to 2.4 gc. The output of the Receiver-Demodulator is suitable for use with: frequency division, pulse code, and time division multiplex; telephone and telegraph equipment, or any other wideband FM carriers.

B. RF PRESELECTOR

A modulated RF signal at the assigned carrier frequency is applied to the RF Preselector (figure 3-1). The RF Preselector is tuned to pass only the assigned frequency to the Tunnel Diode Amplifier. The RF Preselector is a passive type, quarter-wave coaxial bandpass filter, continuously tunable over the entire operating frequency range from 1.7 to 2.4 gc. It is a temperature-compensated, frequency selective device, tuned to accept, with minimum insertion loss, the assigned carrier frequency, and to reject all other frequencies. When properly tuned to the operating frequency, the RF Preselector will exhibit nominal maximally flat bandpass characteristics with a rejection slope of approximately 30 db for each doubling of the bandwidth in the Preselector stopband. **See figure 3-2.**

The RF Preselector consists of five iris-coupled cavities with tuning plungers Z1 through Z5. Each cavity can be compared to a tank circuit which is resonant at some frequency determined by the adjustment of the insertion depth of the tuning plunger. The filter characteristic of the RF Preselector is based on the resonant properties of the one-quarter wavelength coaxial transmission line, where the outer wall of a single cavity of the RF Preselector constitutes the outer conductor of the line,

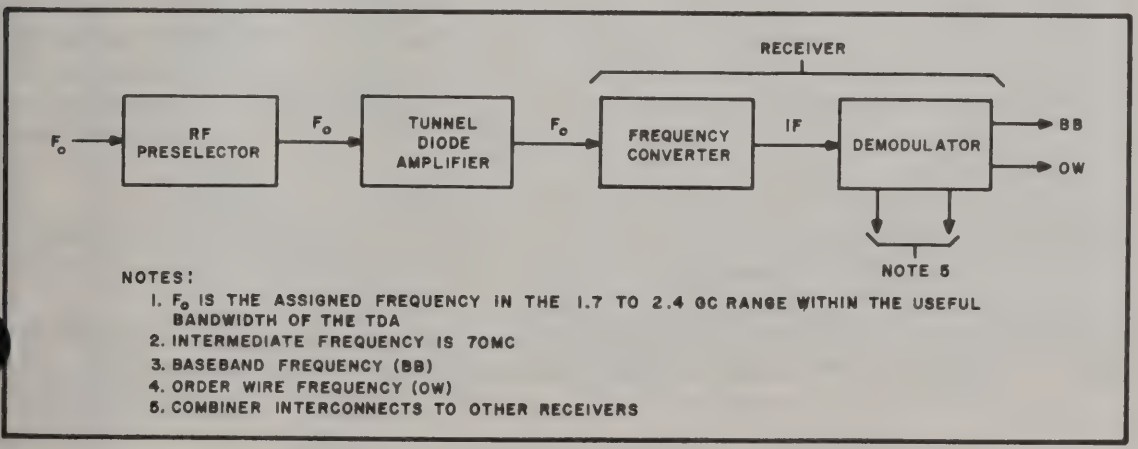

Figure 3-1. Receiving Equipment Configuration

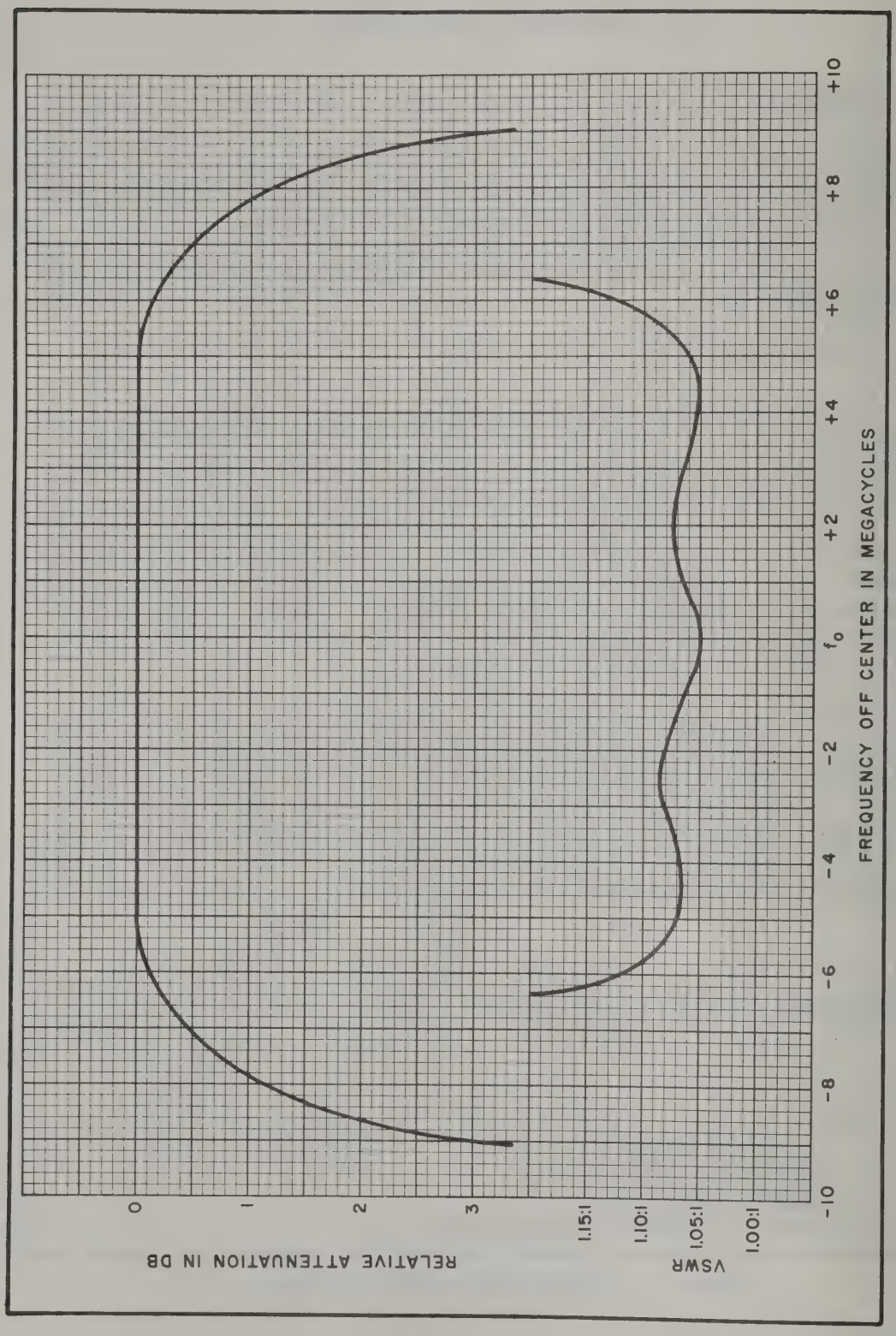

Figure 3-2. RF Preselector Typical Bandwidth and VSWR Characteristics

and is short circuited to the inner conductor at one end. Resonance is achieved by adjusting the length of the inner conductor to a nominal quarter wavelength of the center frequency of the desired passband.

Input and output coupling is achieved by means of fixed (factory adjusted) loops located in a region of strong magnetic field, while rectangular irises are employed throughout the configuration for interstage coupling. All the cavities are inductively tuned and coupled. Both the loops and the irises have been dimensioned and located for optimum VSWR, ensuring nearly constant transfer characteristics anywhere in the operating RF range. See figure 3-3.

The RF Preselector experiences two main types of losses: dissipative and reflective. The dissipative loss is of primary consequence in the passband where reflective losses are held to a minimum. Outside the passband, the preselector becomes increasingly mismatched, thereby causing the undesired frequencies to be rejected or reflected back into the source. Extremely thin iris plates as well as silver plated and highly polished inner surfaces are held to close tolerances in order to keep dissipative losses to a minimum. The RF Preselector is temperature compensated through the use of Invar rods in the tuning assembly. The RF Preselector is a reciprocal microwave circuit, that is; symmetry of construction makes the unit reversible with identical performance characteristics in either direction.

C. TUNNEL DIODE AMPLIFIER *

The modulated RF carrier signal from the RF Preselector is fed to the Tunnel Diode Amplifier (figure 3-1). The Tunnel Diode Amplifier (TDA) is used as an RF Amplifier, in front of the Frequency Converter, to provide an improved Receiver noise figure. The TDA is a low noise, broadband, circulator coupled reflection-type amplifier of coaxial construction, utilizing the negative resistance characteristics of a tunnel diode, that is, a decrease in input voltage causes an increase of output current resulting in amplification of the signal. The amplifier uses a gallium-antimonide type diode and provides low-noise amplification of 17 ±2 db to the input signals in the RF input range of 1.7 to 2.4 gc. Incoming signals pass through the Circulator of the TDA which channels the input energy to the tunnel diode. It then applies the amplified signal to the output port. To attain low noise-figure performance, independent of ambient temperature, an oven enclosure surrounds the tunnel diode module maintaining a stable temperature.

The RF signal is applied to the TDA at RF INPUT jack J1. From J1, the signal is coupled through ports 1 and 2 of Circulator HY1 to Diode CR1. The amplified RF energy is reflected back through port 2 and is coupled through port 3 to RF

*ECN 14487, "Removing The Battery and Modifying for connection to Receiver Power Supply" must be installed on Phase I and II Receivers and on Serial nos. 067 through 070, 071 through 074 and 075 through 078 of the Phase III Receivers.

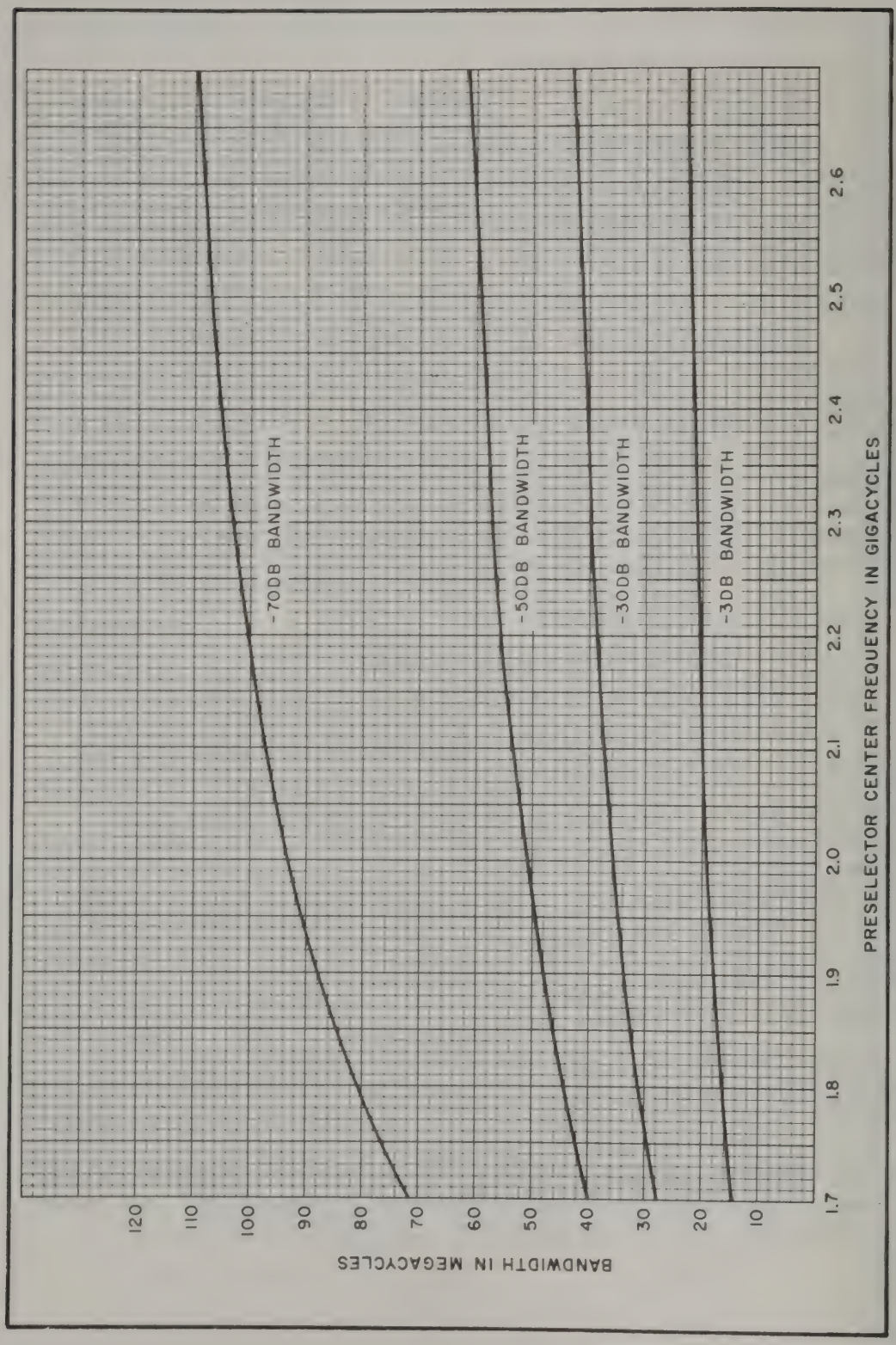

Figure 3-3. Bandwidth as a Function of RF Preselector Center Frequency

OUTPUT connector J2. The DC bias voltage is applied through BIAS ON-OFF switch S2, bias control potentiometer R1, resistors R2 and R3, and is supplied from the Receiver Power Supply-Blower. Heaters HTR1 and HTR2 are thermostatically controlled to maintain the temperature within the Tunnel Diode Amplifier at approximately 50°C. AC power (120 volts AC) is applied to the heaters through fuse F1, HTR ON-OFF switch S1 and thermostat S3.

D. RECEIVER

The Receiver consists of the Frequency Converter, Demodulator, and Power Supply-Blower; all mounted in the Receiver Housing. A modulated RF carrier signal at the assigned frequency is applied to the Frequency Converter where it is mixed with a local oscillator injection frequency to produce the 70-mc intermediate frequency (IF). The modulated IF frequency is fed to the Demodulator where it is amplified, demodulated, and passed through a Combiner to provide the baseband and order wire signals. The Combiner permits diversity operation; whereby, the signal from one Receiver is combined with signals of other Receivers in the system to obtain the best signal-to-noise ratio. For a more detailed description, refer to the paragraphs on the individual drawers.

E. FREQUENCY CONVERTER

1. General

The Frequency Converter (figure 3-4) converts the 1.7 to 2.4 gc RF signal to a 70-mc intermediate frequency. In addition, it provides RF selectivity, low noise figure and IF amplification. The Frequency Converter basically consists of a Converter Preselector, a Crystal Mixer, an Oscillator-Doubler injection string and an IF Preamplifier.

The RF signal is applied to RF INPUT jack J1 of circulator HY1. Circulator HY1 is a fixed tuned, broadband device which provides a minimum isolation of 20 db between its output and input ports. The output of the Circulator is applied to the Converter Preselector. The Converter Preselector is a single cavity low-loss TEM (Transverse Electro-Magnetic) bandpass filter continuously tunable from 1.7 to 2.4 gc. The output of the Converter Preselector is applied to the Mixer. The Mixer heterodynes the input signal from the Converter Preselector with the signal from the injection string and produces the 70-mc intermediate frequency.

The injection string consists of an Oscillator-Doubler, a Low Frequency Amplifier, a 3-db Attenuator, an SRD (Step Recovery Diode) Multiplier and a Circulator.

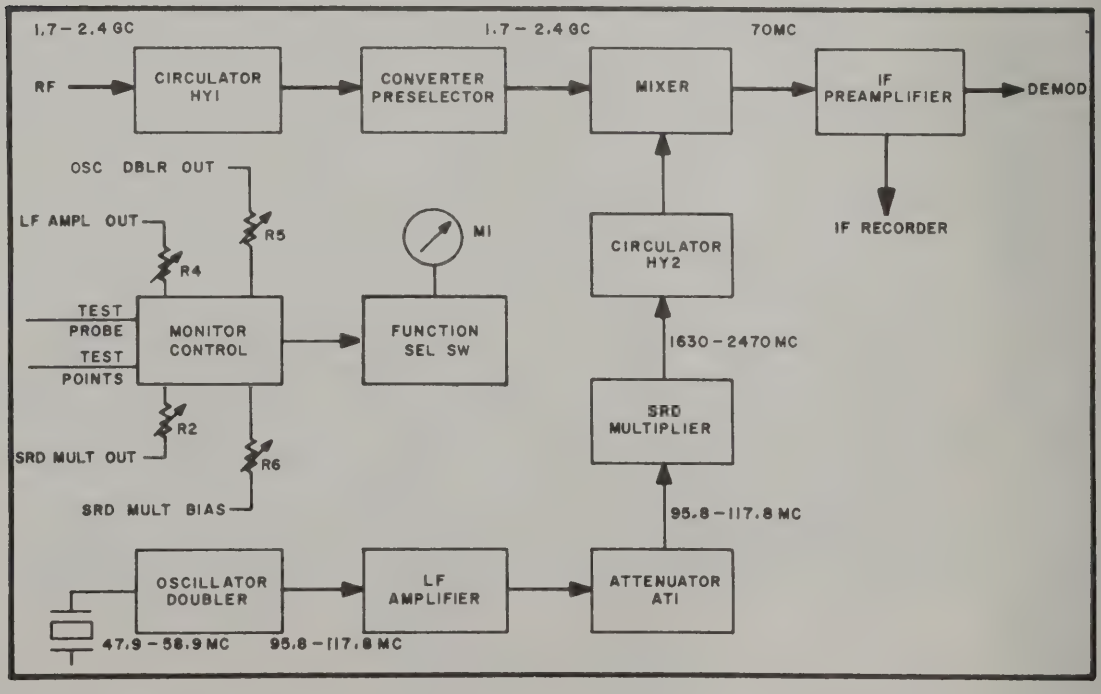

Figure 3-4. Frequency Converter

The Oscillator-Doubler produces a 95.8 to 117.8 mc signal. This signal is amplified by the Low Frequency Amplifier and applied through the 3-db Attenuator to the SRD Multiplier. The SRD Multiplier, multiplies the incoming signal by a factor between 17 and 21, thereby producing an injection frequency in the 1630 to 2470 mc frequency range. The output of the SRD Multiplier is applied through Circulator HY2 to the Mixer where the injection frequency is heterodyned with the incoming RF carrier. The resulting 70-mc intermediate frequency is applied to the IF Preamplifier. The IF Preamplifier is a broadband, low noise, tuned amplifier which provides nominally 30 db of gain for the 70-mc intermediate frequency. The output of the IF Preamplifier is applied to the AGC-controlled IF Amplifier (1). The Monitor Control module is used in conjunction with the Function Selector Switch to monitor the levels of various components on the front panel meter.

2. Converter Preselector

The Converter Preselector consists of a tunable, single cavity, which provides low-loss bandpass filtering over the frequency range of 1.7 to 2.4 gc. Input and output coupling of the Converter Preselector is achieved by means of coupling loops placed at the input and output connectors. The coupling loops provide optimum VSWR, thereby ensuring nearly constant transfer characteristics in the assigned RF range. The output of the Converter Preselector is applied to the Mixer.

3. Mixer

The RF carrier and injection string frequency are heterodyned producing a 70 mc intermediate frequency. The mixer assembly consists of a dual cavity structure which contains a mixer cavity and a local oscillation preselector cavity. Both cavities are realized, using TEM resonators, employing cylindrical center conductors and square outer conductors.

The mixer cavity is tuned to resonance (nominal three-quarter wavelength) at a center frequency of the desired RF carrier in the 1.7 to 2.4 mc frequency range. The mixer crystal is connected to the open-circuited card of the resonator and returned to ground through a cylindrical disc RF bypass capacitor. The mixer cavity is coarse tuned to resonance using a capacitive screw and fine tuned to resonance using an adjustable short-circuit. RF input coupling to the mixer is achieved using a direct tap to the cavity center conductor. This tap location can be adjusted for best conversion loss, using a slider screw mechanism. The point contact mixer diode is connected to a short coaxial cable leading to the input of the IF preamplifier. The cable length has been selected for a noise match between the mixer and the 70-mc IF Preamplifier resulting in optimum overall converter noise figures. Local oscillator injection into the mixer cavity is achieved using a loosely coupled probe.

The local oscillator preselector cavity is tuned to resonance (nominal quarter wavelength) at the local oscillator frequency which is the RF carrier frequency ±70 mc. This cavity acts as a one resonator bandpass filter providing additional selectivity to spurious outputs from the Local Oscillator Injection Chain. The output from the local

oscillator preselector cavity is probe-coupled to a short cable which is connected to the mixer cavity. The output coupling probe from the local oscillator preselector can be adjusted using a slider mechanism, "WHEN MIXER CRYSTAL CURRENT IS TO BE ADJUSTED, THIS SLIDER MUST BE USED RATHER THAN THE PRESELECTOR TUNING CONTROL." The output of the Local Oscillator Injection Chain is loosely coupled to the local oscillator preselector cavity using a small coupling loop terminated in a resistor.

Bandwidth of the single ended mixer is quite broad (about 100 mc). This results in negligible group delay distortion and low conversion loss. Mixer cavity fine tuning uses a dial counter; while, local oscillator preselector cavity tuning employs a tuning indicator. Mixer DC crystal current is metered on the Converter front panel. Crystal replacement is effected readily by removing a small cap. The performance of the overall mixer assembly can be optimized at any frequency within the 1.7 to 2.4 mc range by suitable adjustment of the cavity tuning and coupling adjustments.

4. Local Oscillator Injection Chain

The Oscillator-Doubler produces an RF output in the frequency range of 95.8 to 117.8 mc. The Oscillator-Doubler consists of a crystal-controlled Oscillator stage and a doubler stage mounted in a temperature-controlled oven. The Oscillator stage is a high-stability, crystal controlled, Colpitts Oscillator. Crystal Y1 operates in the frequency range of 47.9 to 58.9 mc. The crystal frequencies may be calculated as follows:

For Carrier Frequency (F_c) = 1700 to 1960 MC

$$\text{Crystal Frequency } (F_x) = \frac{(F_c \pm 70)}{17 \times 2}$$

Except, where dividend is between 1730 to 1836 mc; then, divisor is 36 or 18 X 2. In the dividend, 17 or 18 is the multiplication factor of the SRD Multiplier and 2 accounts for the Oscillator-Doubler.

For Carrier Frequency (F_c) = 1960 to 2100 MC

$$\text{Crystal Frequency } (F_x) = \frac{(F_c + 70)}{21 \times 2} \text{ MC*}$$

*Except where dividend is between 2140 to 2170 mc; then, divisor is 38 or 19 X 2

For Carrier Frequency (F_c) = 2100 to 2400 MC

$$\text{Crystal Frequency } (F_x) = \frac{(F_c \pm 70)}{21 \times 2} \text{ MC}$$

Except where dividend is between 2170 to 2268 mc; then, divisor is 38 or 19 X 2

The parallel tuned circuit, consisting of variable capacitor C6 and tapped inductor L1, adjusts the output frequency of the Oscillator. Frequency vernier capacitor C5 is used as a fine tuning adjust for the Oscillator. The output of the tuned circuit is directly coupled to the base of Doubler Q2. The parallel-tuned circuit, consisting of capacitor C12 and tapped inductor L2, resonates at the second harmonic of the Oscillator frequency, and produces a 95.8 to 117.8 mc output frequency at connector J2. The RF signal at the collector of transistor Q2 is rectified and doubled by the half-wave voltage-doubler consisting of diodes CR1 and CR2, and capacitors C14 and C15. Inductors L12 and L13 and capacitor C21 filter the rectified RF signal and apply it to the monitoring circuit.

The Low Frequency Amplifier increases the level of the Oscillator-Doubler output. It is a three-stage, tuned RF amplifier, that is operated class A. The RF input signal at connector J1 is coupled through capacitor C1 to the base of amplifier Q1. Variable resistor R15 provides a gain adjust for the first amplifier stage. The output at the collector of amplifier Q1 is coupled through the impedance matching network, consisting of variable capacitor C5, fixed capacitors C4 and C10, and inductor L1, to the base of amplifier Q2. Inductor L7 provides a DC return for the base circuit of amplifier Q2. Diode CR1, and capacitors C7 and C8 detect the RF signal at the junction of capacitor C4 and inductor L1 and couple this detected signal to amplifier (1) test point TP2. The operation of amplifier stage Q2 is similar to that of amplifier stage Q1. The amplified RF output of amplifier Q2 is coupled through a second impedance matching network and further amplified by amplifier Q3. The amplified output of transistor Q3 is coupled through capacitor C25 to the parallel tuned circuit consisting of variable capacitor C26 and inductor L3. The output of the parallel tuned circuit is applied to RF output connector J2. The RF output at connector J2 is detected by diode CR3, and capacitors C29 and C33, filtered by inductor L17 and capacitor C19 and applied to the front-panel meter.

The SRD Multiplier uses a step-recovery diode as a harmonic generator which accepts signals in the 95.8 to 117.8 mc range. The SRD Multiplier is used to multiply the signal fed from the Low Frequency Amplifier by a factor between 17 and 21. The output of the SRD Multiplier is then applied to circulator HY2 for application to the Mixer.

The output of the Low Frequency Amplifier, at a nominal level of 840 mw and a frequency between 95.8 and 117.8 mc, is applied to 3 db attenuator AT1. The resultant 420 mw signal is applied to the SRD Multiplier at RF INPUT connector J1. Capacitor C1 couples the signal through inductor L1 to the step recovery diode CR1. This diode, which functions as a switch, is alternately driven from the conducting to nonconducting state by the sinusoidally varying input signal. At the instant that the diode is switched to the nonconducting state, the current through the diode stops very rapidly. This sudden stopping of current flow is termed a "step." This current step contains an infinite number of harmonic frequencies related to the input signal. Since only the harmonic between 17 and 21 is desired, it is necessary to prevent all other harmonics from appearing at RF OUTPUT connector J2. A bandpass filter, consisting

of cavities Z1 and Z2 and an iris, performs the function of allowing only the proper harmonic to pass, while at the same time, suppressing all others.

Input tuning control (capacitor C2) tunes the input circuit so that CR1 is matched to the input line. Capacitor C2 is tuned during the alignment procedure for maximum output at RF OUTPUT connector J2. Bias adjust potentiometer R1 varies the period of conduction of the diode, which in turn controls the harmonic output capability of the diode. During alignment, bias adjust potentiometer R1 and coupling capacitor C6 are adjusted for maximum output consistent with stable operation.

5. IF Preamplifier

The IF Preamplifier is a broadband, low noise, amplifier which provides nominally 20 to 30 db of gain for the 70-mc intermediate frequency. This unit consists of three amplifier stages. The 70-mc intermediate frequency is coupled through capacitor C8 to the base of amplifier Q1. The output of amplifier Q1 is coupled, through capacitor C10 and the tuned circuit consisting of variable capacitors C11 and C12 and transformer T1, to the base of amplifier Q2. Variable capacitor C26 feeds back the output of amplifier Q1 to its input circuit thereby performing a neutralizing function. If capacitor C26 is improperly adjusted, the IF Preamplifier could oscillate. Transistor Q2 provides additional amplification of the 70-mc signal and couples it to two separate circuits. The first path is applied through capacitor C18 and transformer T2 to IF output connector J2. The second path is applied across the voltage divider network consisting of resistors R14 and R13. The output of the voltage divider is coupled through capacitor C17 to the base of amplifier Q3. The amplified output at the collector of transistor Q3 is coupled through capacitor C21, variable autotransformer T3 and the voltage divider consisting of resistor R21, R22 and R23 to recorder connector J3.

6. Metering Circuits

The front panel of the Frequency Converter contains the Status Indicator Meter M1, the Function Selector Switch S1, and the function selector Legend. Colored regions on the meter indicate proper functioning for each position, of the Selector Switch as directed by the Legend. All test outputs from the individual modules in the Frequency Converter and sample of regulated and non-regulated voltage from the Power Supply are applied through the Monitor Control before going to meter M1 except the crystal current which goes directly to the meter. The Monitor Control is a printed circuit card which is located behind the front panel. It contains potentiometers and precision resistors which are adjusted to set proper references on the meter for the different switch positions. The test points which appear in the top part of the Monitor Control Board are connected to the meter by means of the built-in probe.

F. DEMODULATOR

1. General

The Demodulator effectively amplifies and limits the FM signal, removes all AM components and demodulates the FM Signal to a baseband signal. These functions must be carried out without introducing appreciable group delays. Otherwise, the FM components, as a function of baseband frequency, would not only be amplified, but also changed in phase, causing AM-to-PM conversion and consequently intermodulation distortion.

The main circuits of the Demodulator are shown in figure 3-5. The IF Amplifiers and Filter provide an overall gain of 40 db with a nominal 3-db bandwidth consistant with the channel capacity of the Receiver. The output of IF amplifier (2) is distributed to the Wideband Demodulator as well as the Threshold Extension Demodulator. In the Wideband Demodulator, the modulated 70-mc IF is detected in the Discriminator to produce the baseband and order wire frequencies. The Threshold Extension Demodulator is a narrow-band Demodulator. The 70-mc IF is mixed with a 100.5-mc injection frequency to produce a 30.5-mc IF. The 30.5-mc IF is detected in the Discriminator to produce the baseband and order wire frequencies. The AFC Circuits maintain the center frequency in the Voltage Controlled Oscillator. The outputs from both the Wideband and Threshold Extension Demodulators are fed to the Demodulator Transfer Circuit. This is a transient-free transfer device which automatically selects the output from one or the other Demodulator under control of the DC voltage from the Noise Amplifier Circuits. The Type 1130A Receiver does not use the threshold extension circuits. (See figure 3-5.1).

The Receiver employs a postdetection Combiner which permits diversity operation. The baseband and order wire signals from one Receiver are combined with those of one or more other Receivers to achieve the best signal-to-noise ratio. The addition of the signal is directly additive. The addition of the noise components is random in a manner that noise adds as the square root of the sum of the squares. With equal signals the improvement for a quadruple diversity system is 6 db. The Combiner functions with DC control voltage supplied by the Noise Amplifier Circuits.

Final amplification for the Receiver output signals is provided in the Baseband and Order Wire Amplifiers. The Alarm Amplifier monitors the baseband output of the Receiver. The Pilot Amplifier monitors the radio pilot tone and in its absence cuts off or mutes the Receiver Combiner.

2. IF Amplifier Circuits

The overall IF Amplifier consists of two IF Amplifier units separated by an IF Bandpass Filter.

IF Amplifier (1) consists of five stages providing approximately 40 db of amplification. Two stages employing tetrodes are AGC controlled, in order to provide fast AGC action and an AGC range of 40 db. The amplifier's 3-db bandwidth is about

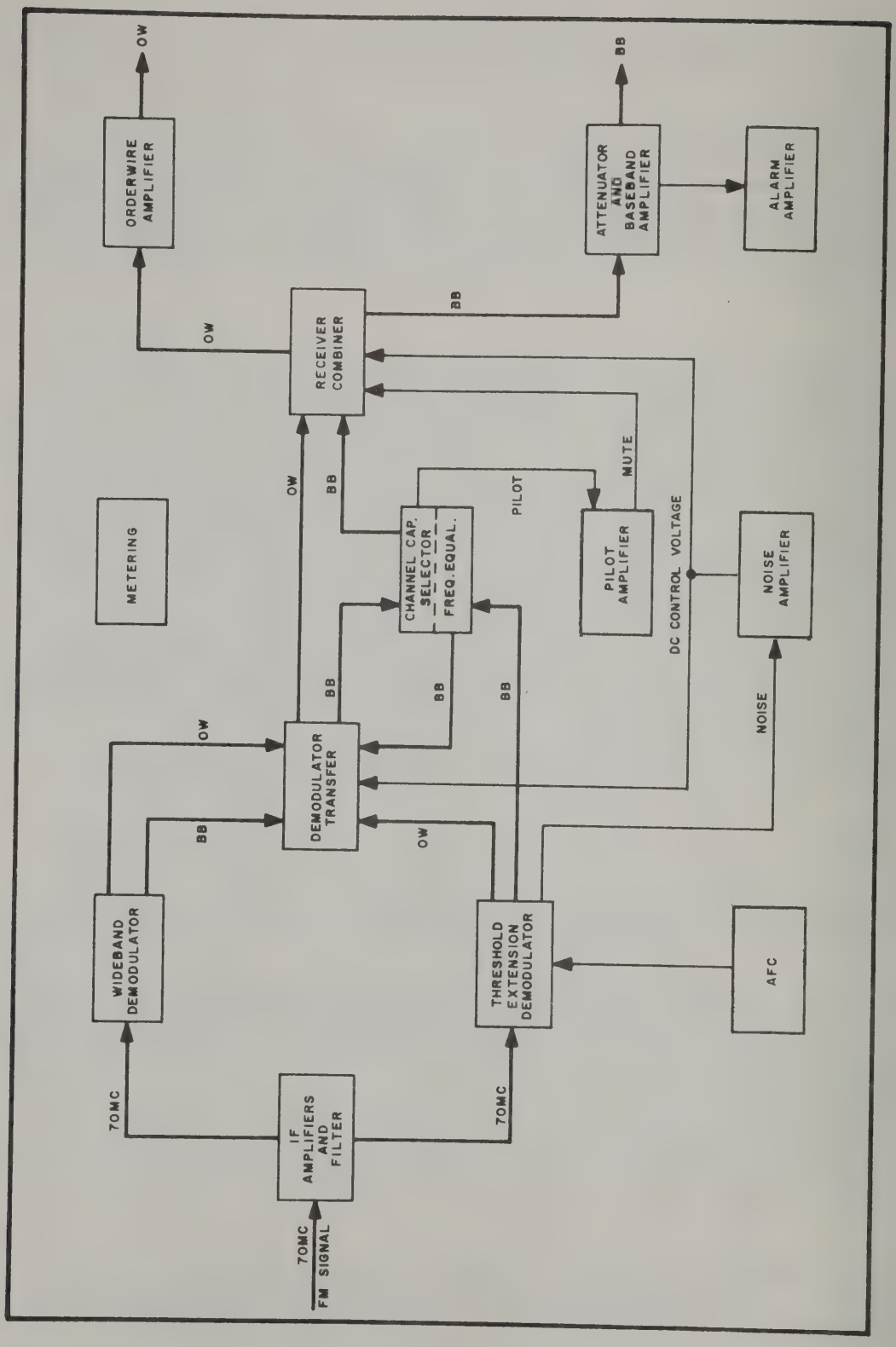

Figure 3-5. Demodulator (Type 1130 Receiver).

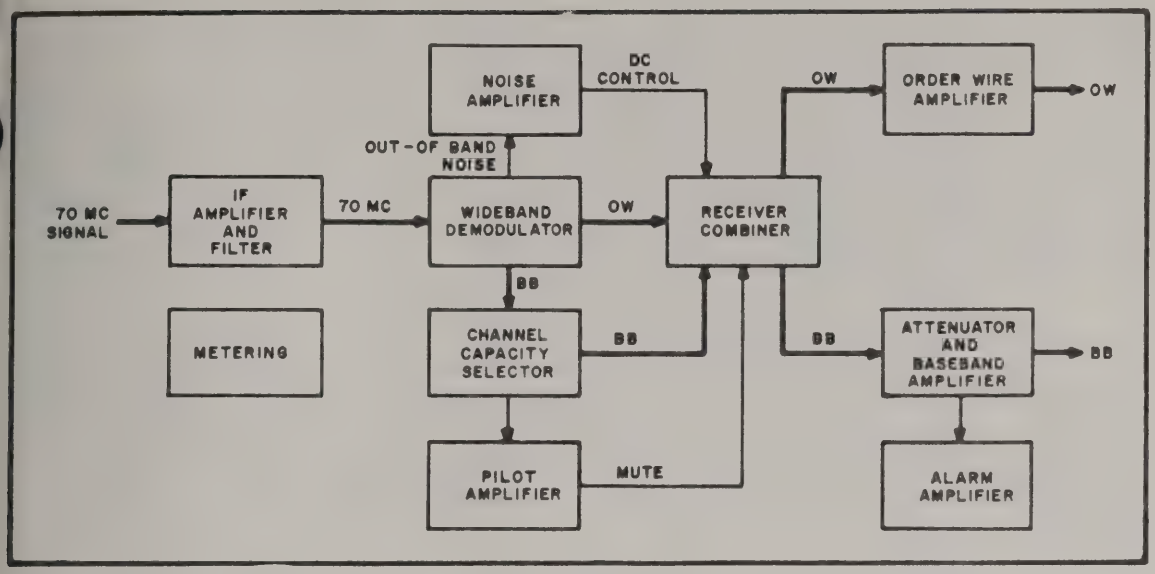

Figure 3-5.1. Demodulator Type 1130A Receiver

18.5 mc resulting in a typical group delay of one nanosecond within ±3 mc from the 70 mc IF center frequency. Alignment of IF Amplifier (1) has been simplified per ECN no. 14651 (Schematic Diagram 23360-02, Revision E) which makes all tuned circuits symmetrical. AGC control has been increased by increasing the gain of the AGC amplifier. A 4-db pad has been added to the output of IF Amplifier (1). This makes the amplifier output VSWR less sensitive to tuning controls and increases the isolation between IF Amplifier (1) and the IF Bandpass Filter. IF Amplifier (1) output VSWR's of less than 1.2:1 are attainable over a bandwidth of over 8 mc.

The IF Bandpass Filter is an 8-pole Gaussian filter that establishes the predetection noise bandwidth of the Receiver. A different filter unit is required for each channel capacity. This group delay is primarily parabolic. Some linear group delay variation will occur due to alignment imperfections and frequency sensitive filter couplings. The IF Bandpass Filter contains pads and impedance matching networks so that satisfactory input/output VSWR's can be obtained using the asymmetrical Gaussian filter networks.

IF Amplifier (2) uses three stages to provide an additional 20-db of gain. Group delay variations within ±3 mc from the 70 mc center frequency are typically less than one nanosecond. The typical 3-db bandwidth of IF Amplifier (2) is 26 mc.

The overall IF Amplifier provides a net gain of 40 db gain in IF Amplifier (1), 20 db loss in IF Bandpass Filter, and 20 db of gain in IF Amplifier (2). The overall IF Transfer Characteristic is shown in figure 3-6. Linear amplification occurs for IF signal inputs up to about -45 dbm. Stronger signals are subject to AGC resulting in constant IF outputs of about +4 dbm for IF inputs within the range of -30 dbm to +3 dbm. For 50 ohm output impedance levels, the limiting IF Amplifier output delivered to the Compressor-Limiter in the Wideband Demodulator will be about 350 millivolts. A minimum IF input signal level of -70 dbm is required to drive the Compressor-Limiter. This corresponds to a minimum IF output of -30 dbm (7 millivolts).

3. Wideband Demodulator

The Wideband Demodulator is used to detect the frequency modulated IF, to produce the baseband and order wire frequencies. It consists of a Compressor-Limiter, a Driver-Discriminator, and a Distribution Amplifier (figure 3-7).

a. Compressor-Limiter

The Compressor-Limiter consists of rapid acting compressors which remove all amplitude modulation. It maintains constant amplitude to the driver over a large dynamic input range (10 mv to 500 mv) with minimum AM-to-PM conversion. The Compressor-Limiter, is used in conjunction with a Driver-Discriminator. The input at jack J1 is supplied by IF Amplifier (2). The Compressor-Limiter has two outputs; the first output at jack J4 is used for 70-mc Radio Relay operation; the second output at jack J6 is fed to the Driver-Discriminator.

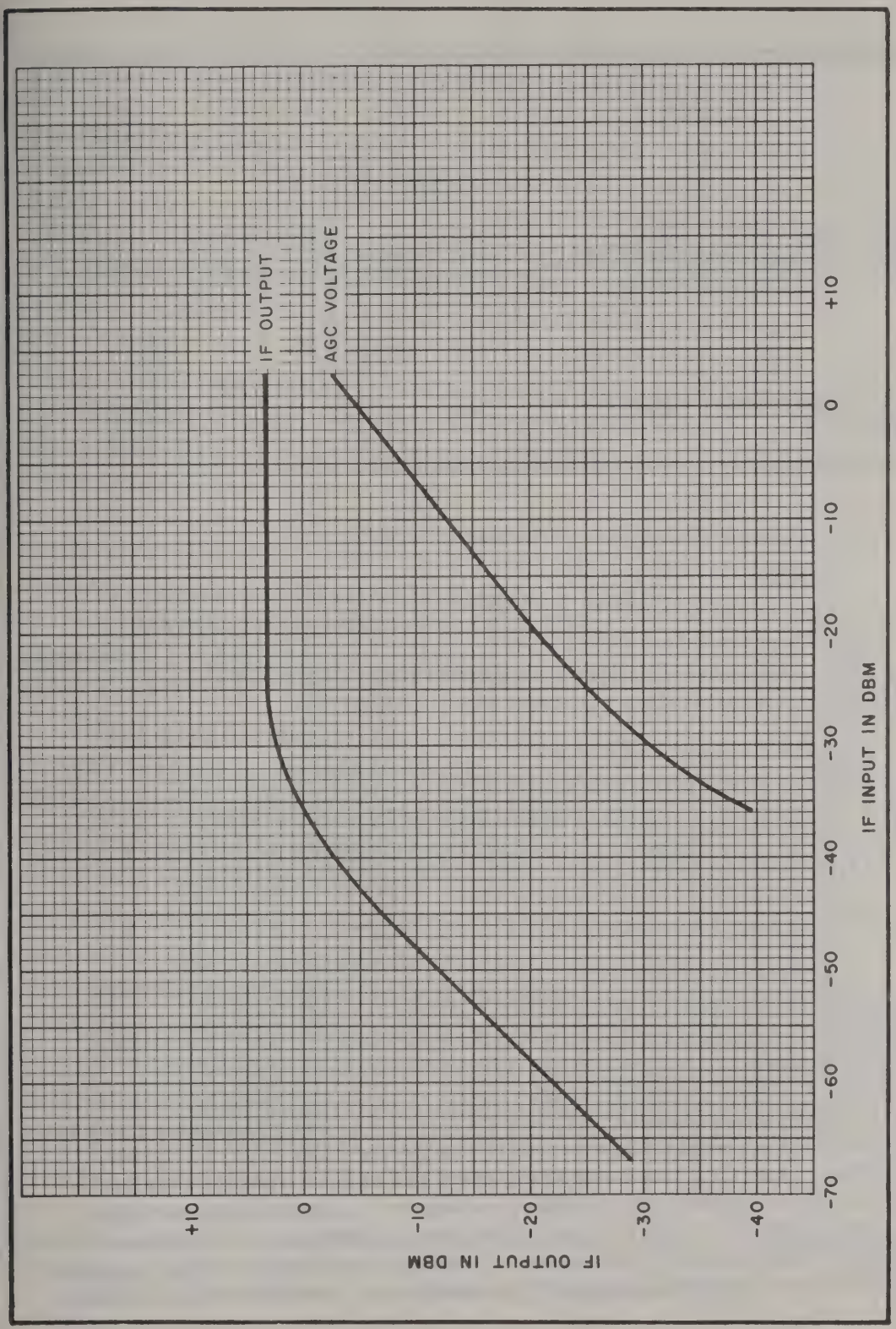

Figure 3-6. Overall IF Transfer Characteristics

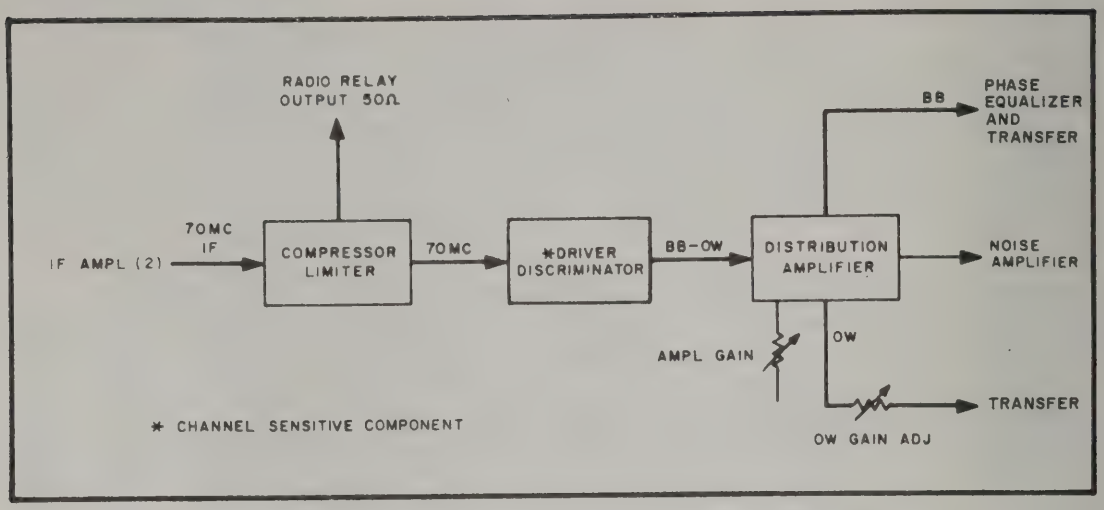

Figure 3-7. Wideband Demodulator

The Compressor-Limiter consists of six stages of compression, an amplifier, and two output drivers (figure 3-8) to attain rapid and efficient AM suppression. The six cascaded compressor stages have a total bandwidth of 1 db in excess of 60 mc. The Compressor-Limiter is designed to limit, based on Receiver thermal noise. Limiting of the first stage occurs at an input signal level of 1.25 mv. To place a minimum burden on the Compressor-Limiter, the AGC characteristics of the IF Amplifier maintain a nominal input of 350 mv starting at an IF input level of -30 dbm. The Wideband Demodulator maintains constant group delay from below threshold signals, to very high signal levels. The six stages of limiting employed assure constant baseband output levels within better than a 0.25 db from threshold to signal levels exceeding 0.0 dbm. Typical Compressor-Limiter characteristics are shown in figure 3-9.

b. Driver-Discriminator

The Driver-Discriminator must be changed to accommodate different channel capacities. The Driver-Discriminator detects the FM signal received from the Compressor-Limiter and applies it to the Distribution Amplifier. The Driver-Discriminator consists of an input driver stage feeding a Discriminator circuit whose detected output is applied through an emitter-follower to the Distribution Amplifier. The Discriminator circuit (figure 3-10) consists of discriminator transformer T1 and dual diode detectors CR1 and CR2 connected in a switching-mode type of detector. This circuit is a phase-discriminator, whose operation depends upon the phase relationships between the primary and secondary voltages of a tuned transformer when the input signal frequency is close to that of the resonant frequency. The primary and secondary of transformer T1 are tuned to 70 mc by Disc Primary Adjust capacitor C7 and Disc Secondary Adjust capacitor C9, respectively. The input signal applied to

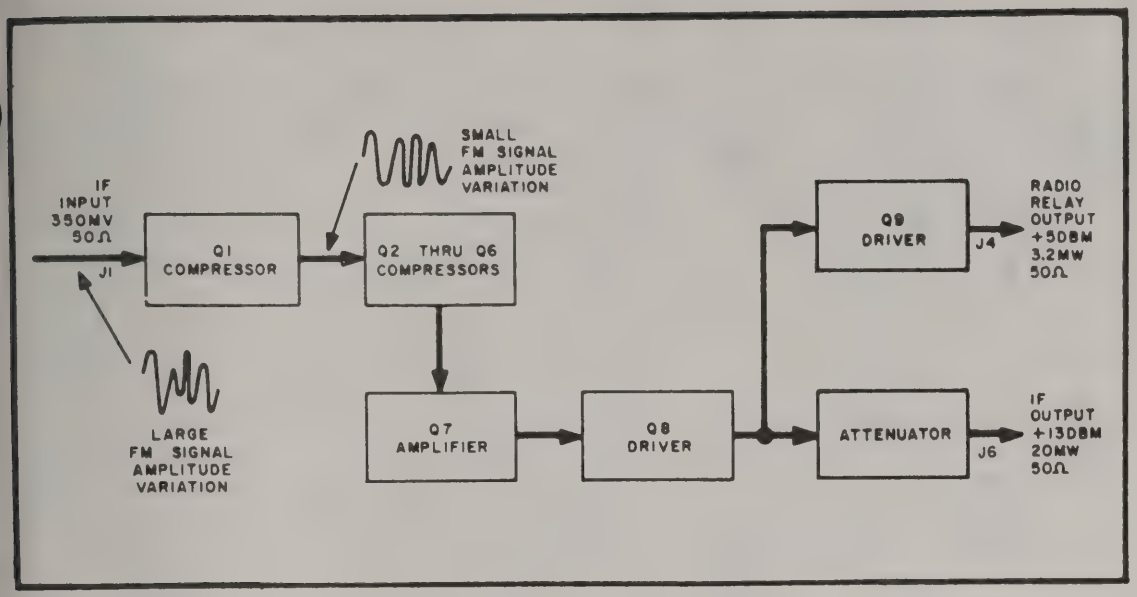

Figure 3-8. Compressor-Limiter

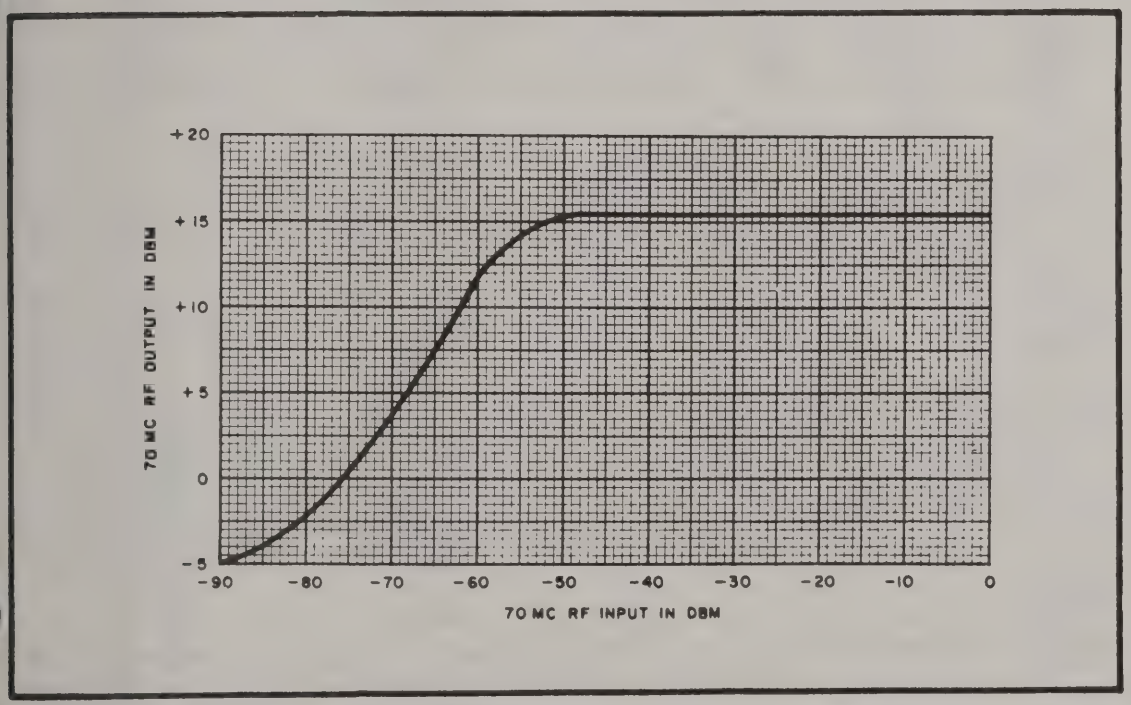

Figure 3-9. Typical Characteristics, Compressor-Limiter

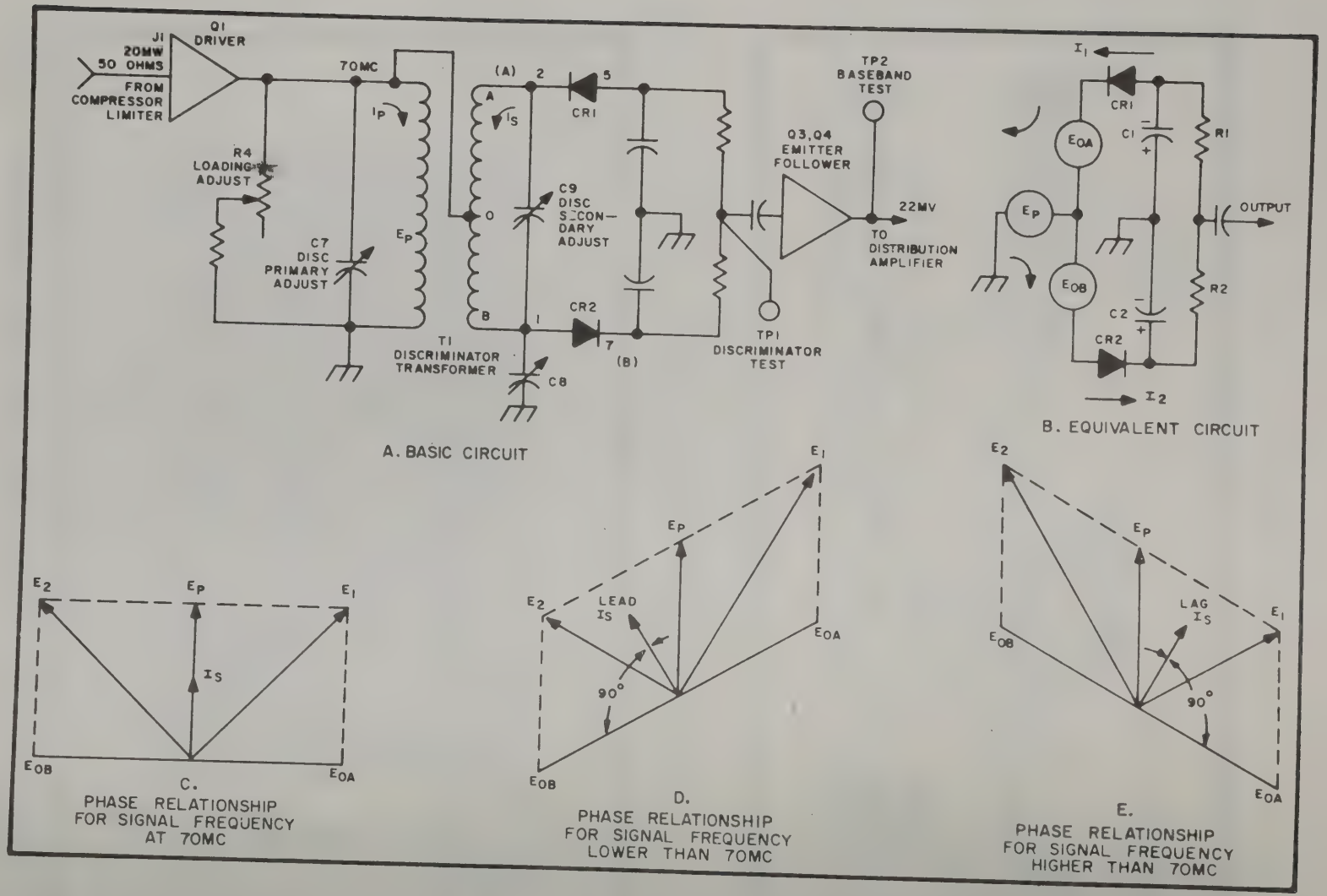

Figure 3-10. Discriminator, Simplified Circuit and Vector Analysis

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the primary of transformer T1 is also connected directly to the center tap of the secondary. This connection results in an equal in-phase voltage at points A and B.

The voltage induced across the secondary, as a result of the mutual coupling between primary and secondary, leads in phase by 90 degrees. The in-phase primary voltage is applied to the center tap of the secondary, and the induced voltage at point A, with respect to the center tap leads by 90 degrees. Since point B must be 180 degrees away from point A, the voltage at point B leads by 270 degrees with respect to the voltage applied at the center tap. These phase relationships however, are exact only at resonance, and the inductive and capacitive reactances in the series-resonant secondary circuit are equal. When the input frequency shifts from the resonant frequency, the induced phase relationships are slightly altered. If the input frequency is higher than the resonant frequency, the inductive reactance of the secondary circuit exceeds the capacitive reactance. The secondary thus presents a primarily inductive load. The secondary voltages at points A and B lead the input voltage by a greater amount than at resonance. Similarly, when the input frequency is below the resonant frequency, the secondary presents a capacitive load and the secondary voltages lead the input voltage by a smaller amount than at resonance.

Part B, figure 3-10 is a simplified version of the voltage and current relationships in the discriminator circuit. The primary voltage and the voltage drops in the secondary are replaced with their equivalent generators. The total voltage which acts on diode CR1 is the vector sum of voltage E_{OA} and E_P (part C, figure 3-10). The voltage acting on diode CR2 is the vector sum of voltages E_{OB} and E_P. These sum voltages are designated E_1 and E_2, respectively, and their magnitude depends upon the phase difference between voltages E_P and E_{OA} and voltages E_P and E_{OB}.

Current I_1 through diode CR1 can be traced from ground through capacitor C1, diode CR1, generators E_{OA} and E_P, and back to ground. In a similar manner, current I_2 can be traced through generators E_P and E_{OB}, diode CR2 and capacitor C2. DC Currents I_1 and I_2 charge capacitors C1 and C2 to the polarity shown in part B, figure 3-10. The DC voltages across the capacitors are of equal amplitude at resonance, because voltages E_1 and E_2 are equal (part C, figure 3-10). When the signal frequency is equal to the resonant frequency of 70 mc, voltages E_{OA} and E_{OB} have the same amplitude and are both 90 degrees out-of-phase with voltage E_P. Voltage E_{OA} is rectified by diode CR1 to charge capacitor C1 to a negative voltage equal in magnitude to the positive voltage across capacitor C2. The voltages across the capacitors, taken in series, are applied across load resistors R1 and R2. Because capacitors C1 and C2 are charged to equal and opposite voltages with respect to ground, the voltage at the junction of load resistors R1 and R2 remains at ground potential.

When the input frequency to the Discriminator is lower than the 70-mc resonant frequency, the output voltage is no longer zero. Because inductive reactance decreases, and capacitive reactance increases with a decrease in frequency, the secondary circuit then appears capacitive. As shown in part D, figure 3-10, the phase of current I_S is advanced from the reference, because current leads voltage in a

capacitive circuit. Voltages E_{OA} and E_{OB} remain 90 degrees out-of-phase with current I_S and are also advanced in phase. When voltages E_{OA} and E_{OB} are added t voltage E_P, voltage E_1 is greater than voltage E_2 because the phase difference betw voltages E_P and E_{OA} has been reduced, while the phase difference between voltages E_P and E_{OB} has increased. Capacitor C1, therefore, charges to a negative voltage larger in amplitude than the positive voltage to which capacitor C2 charges. As a result, the output voltage at the junction of resistors R1 and R2 is negative.

When the input frequency to the Discriminator circuit is greater than the 70-mc resonant frequency, the secondary circuit appears inductive, and current I_S lags reference voltages E_P and E_S. As shown in part E, figure 3-10, voltage E_2 is then greater than voltage E_1 because the phase difference between voltages E_P and E_{OB} has been reduced, while the phase difference between voltages E_P and E_{OA} has increased. Capacitor C2 therefore charges to a positive voltage larger in amplitude than the negative voltage to which capacitor C1 charges. As a result, the output voltage at the junction of resistors R1 and R2 is positive. The polarity of the output voltage and frequency appearing at the junction of resistors R1 and R2 varies at a ra proportional to the modulation level and frequency. This voltage is coupled through capacitor C3 into emitter followers Q3 and Q4. The emitter-follower output is fed t the Distribution Amplifier.

Figure 3-11 shows typical characteristics of the Discriminator (output voltage versus frequency deviation from 70 mc). The usable bandwidth is determine by the range over which the Discriminator characteristic curve is linear. Resistor R4 connected across the primary of discriminator transformer T1 increases the bandwidth of the detector by reducing the Q of the tuned secondary. Because the Discriminator type of phase detector responds to amplitude as well as frequency variations, out-of-band noise above the highest signal frequency appears in the outpu if the signal is not strong enough to supply full limiting. The composite signal from the Discriminator consists of: baseband, order wire, and noise. The output of the Discriminator is fed to the Distribution Amplifier.

c. Distribution Amplifier

The Distribution Amplifier is a transistorized, low noise and low distort amplifier which separates and distributes signals from the Driver-Discriminator. T input stage consists of two transistors in parallel to improve the noise figure. The cascade emitter-follower in the output stage provides sufficient impedance isolation between the Amplifier and the loads and insures that sufficient power can be delivere to the three separated outputs.

The simple RC high-pass filter in the baseband output section is used to remove low frequency components. The baseband output is fed to the Channel Capac Selector and the order wire output is fed to the Combiner. The low-pass filter, in the order wire circuit, is used to eliminate the baseband frequency signals. Potenti eter R26 is used to set the order wire level to the Order Wire Combiner. The (out-o band) noise output is fed to the Noise Amplifier Circuits.

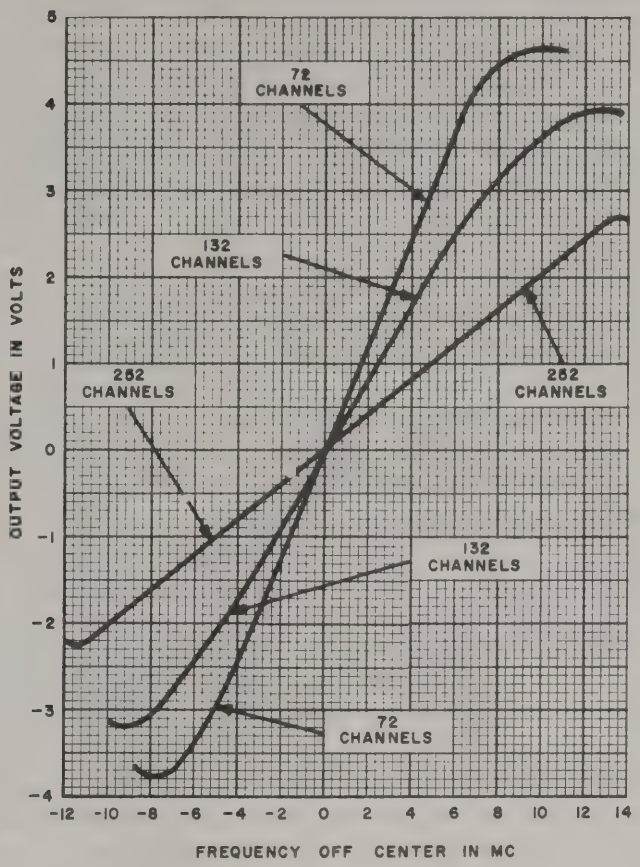


Figure 3-11. Typical Discriminator Characteristic Curves

4. Phase Equalizer (Type 1130 Receiver only)

The Phase Equalizer must be changed to accommodate different channel capacities. It compensates for the phase-delay encountered by the baseband signal passing through the Threshold Extension Demodulator. That is, it introduces a phase-delay equal to the phase-delay which would be encountered by the baseband signal when it is channeled through the Threshold Extension Demodulator. The output of the Phase Equalizer is applied to the Demodulator Transfer Circuit.

5. Threshold Extension (Type 1130 Receiver only)

a. General

The term Threshold Extension applies to methods applicable in FM Receivers that produce a usable output at input signal values below the normal Receiver threshold. Threshold Extension automatically provides a lower Receiver threshold whenever the carrier signal input level drops to within 7 db or less of the normal Receiver threshold.

The operation of Threshold Extension is based on the principle of compressing the deviation by means of FM feedback. The demodulated output of the Limiter-Discriminator, upon suitable correction and amplification, modulates a Voltage Controlled Oscillator (VCO). The 100.5-mc output of this VCO is used as the local oscillator injection for the Mixer. The 70-mc IF input to the Threshold Extension Demodulator is mixed with the local oscillator frequency of 100.5 mc. The 30.5-mc difference frequency output of the Mixer is amplified through the Bandwidth Selector and applied to the Limiter-Discriminator. The Bandwidth Selector is the noise-band restricting device, which consequently achieves a lowering of the FM threshold. The IF input to the Mixer deviates the normal amount. This deviation is reduced by the loop feedback factor which is transmitted through the VCO. As an example, if the normal deviation is 1.2 mc and 6 db of feedback is used in the system, the deviation is reduced to 600 kc. If the bandwidth of the Shaping Filter is now 1.0 mc at the ±3 db or half power points, it can be seen that the new deviation spectrum is completely transmitted through the Bandwidth Selector without being distorted. Since, for the higher baseband frequencies, the Bandwidth Selector offers some phase shift in the overall feedback loop, the deviation reduction decreases somewhat with high frequencies. Therefore, the Threshold Extension Demodulator is as wide as possible to minimize phase shift. The Wideband Amplifier has no appreciable phase shift at the baseband frequencies in question.

From a practical point of view, the Threshold Extension Demodulator is in operation over a dynamic range of not more than 12 db. The transferring of the Wideband Demodulator to the Threshold Extension Demodulator will occur approximately 7 db before the normal threshold is approached. This transition is practically instantaneous and transient free. To protect the Mixer from harmonics and a consequential disturbance of the feedback loop, a Shaping Filter is used before the Mixer. Its bandwidth varies as a function of channel capacity. Since the 30.5-mc Discriminator sensitivity is approximately 200μv per kc/rms and the Reactance Modulator sensitivity is nominally 90μv per kc/rms we have, due to the Demodulator-Modulator combination, a loop gain of 7 db.

The output of the Limiter-Discriminator drives the Wideband Amplifier with the demodulated pilot, noise, baseband, and order wire signals. The baseband output is adjusted to a level identical to the baseband level existing in the Wideband Demodulator output. This signal is applied to a fast acting Baseband Transfer Circuit.

Both the baseband information derived from the regular channel, and that derived from the extended threshold channel, appear at the input transistors of the Baseband Transfer Circuit. Depending on the level of the DC control voltage from the Noise Amplifier, the Baseband Transfer Circuit selects either one or the other output. The order wire signals are transferred separately in a similar manner. Therefore, the outputs of the Threshold Extension Demodulator can supply the normal baseband and order wire inputs for the Combiner.

The effective bandwidth of the Threshold Extension Demodulator can vary between 750 kc and 2 mc. AFC (automatic frequency control) is used to assure that the VCO frequency will stay within 1% of the lowest IF bandwidths in question. The total AFC loop gain is 46 db. The AFC voltage is derived from the 50.25 mc Driver-Discriminator. Since 46 db of AFC gain is used, the maximum VCO frequency fluctuation is kept to a small proportion. The maximum drift over a monthly period is well within ±5.0 kc. A solid-state oven controlled VCO is used to achieve a VCO stability which has less than ±1.5 kc variation per day at 100.5 mc.

b. T. E. Demodulator

The T. E. Demodulator is shown in figure 3-12. The modulated 70-mc signal from IF Amplifier (2) is fed through the Shaping Filter to the Mixer. The Shaping Filter protects the Mixer From harmonics generated in the feedback loop.

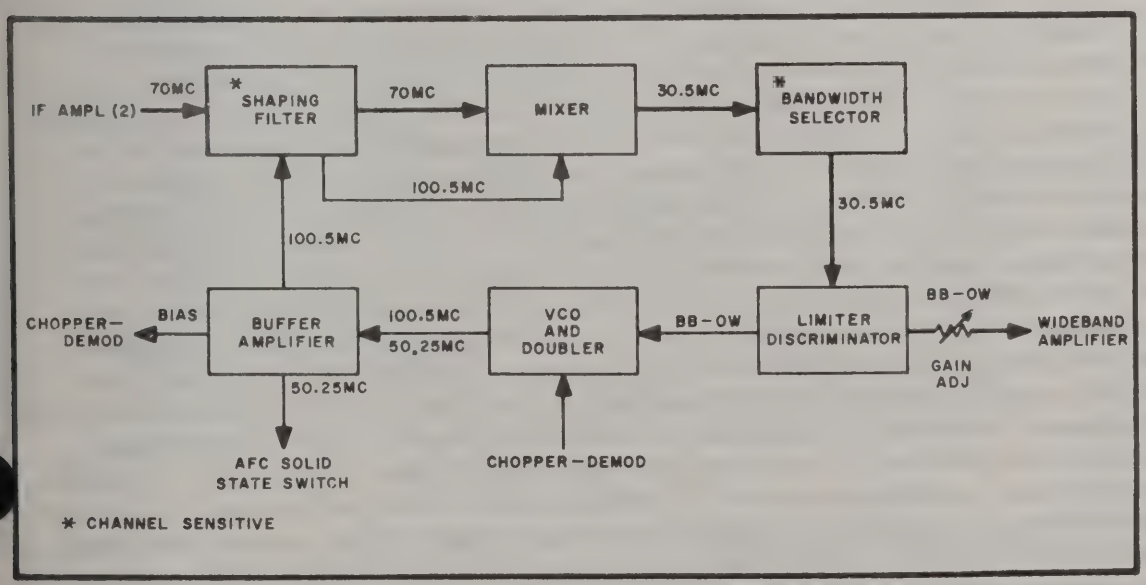


Figure 3-12. Threshold Extension Demodulator

The Mixer is a transistorized down-converter used in threshold extension where an additional frequency conversion is necessary to reduce the overall deviation. Degeneration of the FM signal takes place in this stage because the modulation of the VCO output is applied out-of-phase to the incoming modulation signal. In the Mixer, the 70-mc IF is heterodyned with a 100.5-mc injection frequency. The difference frequency of 30.5 mc is extracted by the use of a tuned coupling circuit. This circuit acts as an IF Amplifier for selective filtering. The output of the Mixer is applied to the Bandwidth Selector.

The Bandwidth Selector is a solid-state active-element bandpass filter consisting of two 30.5 mc tuned frequency amplifiers. It is used to restrict the noise band, thereby lowering the FM threshold of the Receiver. It must be changed to accommodate different channel capacities. The Bandwidth Selector provides the specific bandwidth reduction for the Threshold Extension section at a center frequency of 30.5 mc with an overall unit gain of 7.5 db nominal. The center frequency of the tank circuit is adjustable by capacitor C12. The second amplifier section provides the impedance matching of 50 ohms. The Bandwidth Selector also contains a diode bridge for monitoring the output level. The output of the Bandwidth Selector is applied to the Limiter-Discriminator.

The Limiter-Discriminator consists of rapid-acting compressors and limiters which remove all AM. It offers a constant amplitude output over a large dynamic input range with minimum AM-to-PM conversion. It has one input at J1 and two outputs; one output at J4 drives the VCO and Doubler, the second output at P1 drives the Wideband Amplifier. Compressor Level potentiometer R58 is used to set the deviation of the VCO for the proper compression ratio (5.5 db).

The Limiter-Discriminator consists of three stages of compression followed by three stages of limiting. To attain rapid and efficient AM suppression, extremely high gain transistors are used. These transistors are operated with a G_m of 200,000 mhos. The cascaded six compressor limiter stages have a 3-db bandwidth in excess of 50 mc. No tuning is required because all interstage capacitance is carefully controlled by printed circuit wiring. The input capacitance of the transistor is isolated through a resonant circuit using a fixed coil and further through a resistive voltage divider. The collector output capacitance of 1 to 2 micro micro farads resonates with a fixed coil and does not vary substantially from transistor to transistor. A pair of diodes are connected in opposite and parallel fashion between the collector and base voltage-divider so that the positive and negative half cycles of the signal are each loaded by the forward resistance of one diode. The forward resistance of one diode is a nonlinear function of the applied signal and decreases as the signal amplitude increases. As a result, large input variations at the base of the compressors and limiters are amplified less and amplitude compression takes place in the AC collector load circuit. Limiting occurs at a 0.7 peak-to-peak voltage, in the interstage circuit. Since the base capacitance is isolated by the base voltage divider, no variable capacitance due to "Miller" effect is reflected across the diodes. This eliminates AM-to-PM conversion which normally is introduced due to "Miller" effect of the next input stage. It is important to note that any AM-to-PM conversion introduces intermodulation

distortion as a function of varying level. The first stage is normally most severely affected. Each stage has a current degeneration resistor in the emitter to minimize "Miller" effects.

The transistors are operated Class A to assure that no limiting exists in the transistors which would otherwise handicap the diode limiting. The maximum peak-to-peak voltage that can be developed between states is 0.7 volts peak-to-peak. This voltage is divided by 2:1 with 0.35 volt peak-to-peak appearing at the base of the transistor. Since the base swing is 0.7 volts linear operation is attained with an applied signal of 0.35 volts. The input impedance is adjusted by means of a resistive "tee" circuit to 50 ohms. The input VSWR is 1:25:1 at 30.5 mc. The Limiter-Discriminator is designed to limit on received thermal noise. Limiting of the first input stage occurs at -30 dbm or 7 mv. The characteristics of the Limiter-Discriminator is shown in figure 3-13.

The output of the limiter portion is fed through a 16 mc bandwidth discriminator portion designed to eliminate most of the undersirable by-products. The Limiter-Discriminator has maximum intermodulation distortion of -35 db. The discriminator is a switching type of detector. The output is fed in parallel through phase-inverter Q10, and emitter followers Q8 and Q9 to the final output connectors P1 and J4, respectively. Emitter follower Q8 contains a switch to disconnect it from the circuit,

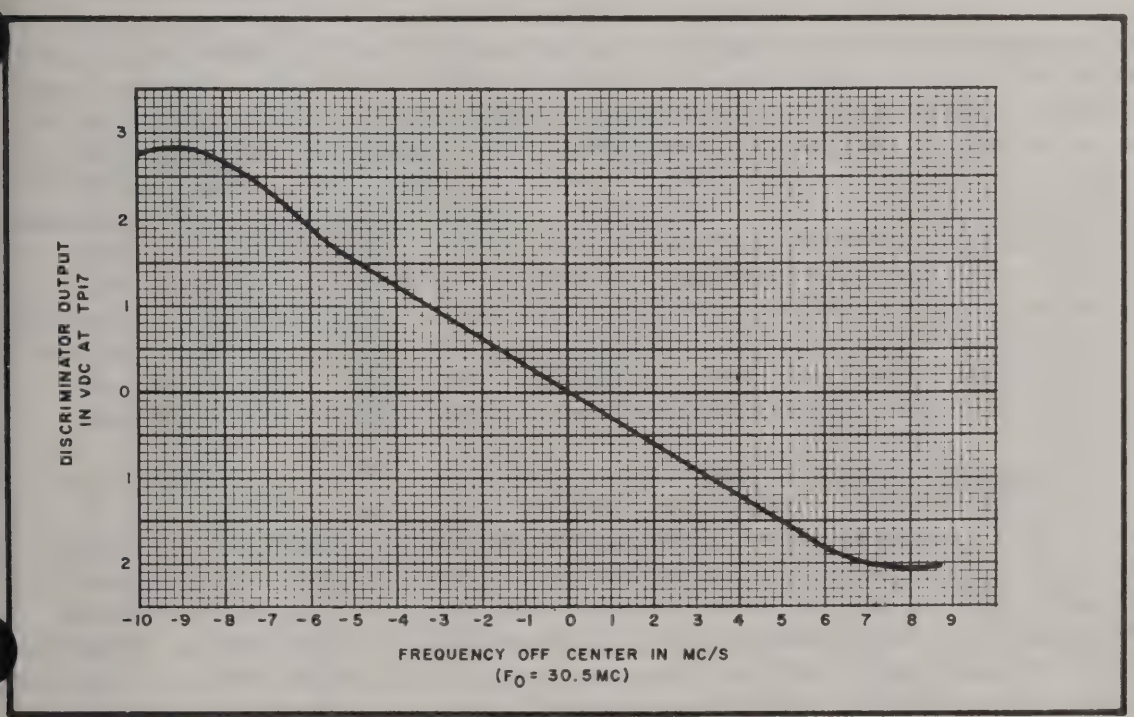


Figure 3-13. Limiter-Discriminator Characteristics

and emitter follower Q9 has a gain control, which is used to set the deviation of the VCO to the proper compression ratio (5.5 db). The output level at J4 is between 2.9 and 12 mv rms, and is fed to the VCO and Doubler. The output at P1 drives the Wide band Amplifier with the demodulated signals. The output level at P1 is between 13.5 and 30 mv rms.

c. T.E. Loop

The Threshold Extension Loop consists of the VCO and Doubler, and the Buffer Amplifier (figure 3-9). The VCO and Doubler is a varactor voltage-controlled oscillator and frequency-multiplier whose circuitry is stabilized by a temperature controlled oven. The first stage, an emitter follower with its associated frequency determining network consisting of CR1, C2 and L3 forms a basic "Hartley" oscillator circuit. The DC bias voltage across the diode, and the frequency excursions of the error signal input from the Limiter-Discriminator, varies the capacitance of the varactor. This changes the resonance in the tank circuit which in turn changes the oscillator frequency. The result is a frequency modulated carrier dependent upon its input bias characteristics. The basic oscillator frequency of this VCO is 50.25 mc. The second stage is a frequency doubler which is used to generate the second harmonic (100.5 mc) of the VCO frequency. The output of the VCO and Doubler (50.25 and 100.5 mc) are fed to the Buffer Amplifier.

The Buffer Amplifier is a solid-state amplifier. RF input signals from the VCO and Doubler at 50.25 and 100.5 mc are amplified and distributed through their respective RF output connectors. The Buffer Amplifier consists of two high frequency amplifiers, one for the AFC loop to provide isolation, and the other as a buffer stage before the Mixer. The isolation amplifier is essentially an amplifier circuit tuned to 50.25 mc, providing a nominal gain with a 10 mc bandwidth to allow proper operation of the low frequency AFC loop. The Buffer Amplifier is essentially a wideband amplifier designed to exhibit unity gain over a wide spectrum of frequencies. The biasing network applies the proper DC bias for the VCO and Doubler. Potentiometer R8 is the coarse and potentiomenter R11 is the fine adjustment for the bias network. A normally open pushbutton switch is used to test the performance of the automatic frequency control (AFC) loop. When the switch is pressed, the AFC circuit is disabled, allowing the VCO to run free. Normal operation occurs when the pushbutton is not pressed.

6. Wideband Amplifier (Type 1130 Receiver only)

The Wideband Amplifier is a transistorized wideband resistance coupled feedback amplifier consisting of two amplifiers, each of which is followed by an emitter follower. Wideband signals from the Limiter-Discriminator are applied to the base of amplifier Q1. Amplifiers Q1 and Q3 are essentially RC coupled devices. Transistor Q1 has a nominal gain of 44 db and transistor Q3 has a nominal gain of 16 db. The first emitter follower Q2 is an impedance-transforming device which provides the necessary isolation between the two amplifiers. The dual emitter-follower output stage, consisting of parallel transistors Q4 and Q5, develops the necessary power across a 75-ohm load with low modulation distortion. Capacitor C16 is used to couple the emitters of

transistors Q4 and Q5, thereby avoiding a direct DC connection and eliminating any possibility of thermal unbalance.

The open loop gain of the amplifier is 60 db, when measured prior to the 6-db matching loss. In order to obtain the required gain and linearity, 34 db of negative feedback is introduced from the output stage to the emitter of the first stage. This is accomplished through an RC feedback network, thereby reducing the gain of the Wide-band Amplifier to 26 db. Trimmer capacitor C15, in the feedback loop, flattens the high frequency response of the amplifier and introduces a leading phase-shift which improves the gain-phase margin by approximately 3 db. Additional correction is introduced via a phase-correction network consisting of C9 and R12. This also improves the gain-phase margin of the unit. When the amplifier is terminated in 75 ohms, a 6-db loss is obtained, reducing the gain to 20 db. The input impedance of the amplifier is approximately 1000 ohms which imposes a negligible amount of loading on the preceding attenuator. Gain potentiometer R5, in the input circuit, insures a constant frequency response and is accessible from the top of the printed circuit card. The baseband output is fed through the Frequency Equalizer in the Channel Capacity Selector to the Demodulator Transfer Circuit. The order wire output is fed directly to the Demodulator Transfer Circuit. The noise output is fed to the Noise Amplifier Circuits.

7. AFC Circuits (Type 1130 Receiver only)

a. General

The AFC Circuits (figure 3-14) consist of the Solid-State Switch, Compressor-Limiter, Driver-Discriminator, Error Amplifier, Chopper Demodulator and Reference Oscillator. AFC (automatic frequency control) is used to assure that the

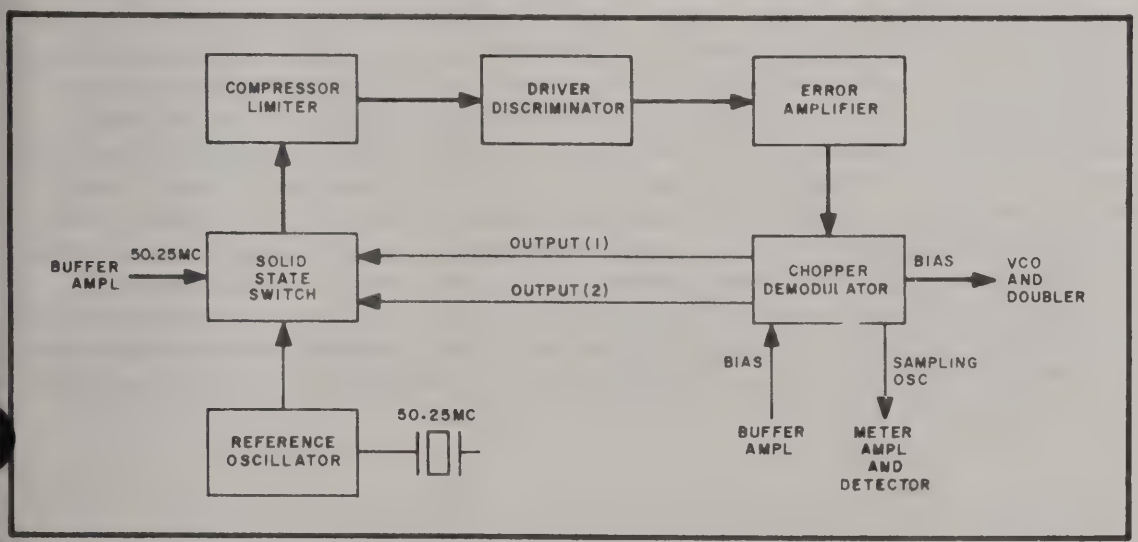


Figure 3-14. AFC Circuits

VCO frequency is within 1% of the lowest IF bandwidth. The total loop gain of the AF Circuit is 46 db. The AFC voltage is derived from the 50.25 mc temperature controlled Discriminator. Since 46 db of AFC gain is used, the maximum VCO frequenc fluctuation is kept to a very small proportion.

b. Reference Oscillator

The AFC Reference Oscillator is a crystal controlled transistorized "Butler" oscillator. The reference oscillator consists of a two stage emitter-coupled series-mode oscillator where the second stage is a buffer amplifier tuned to the crystal frequency. The first stage is a common base amplifier with the collector tuned to the 50.25 mc crystal frequency. Negative feedback is introduced from the emitter of the second stage to the base of the first stage. The negative feedback incorporated reduces the crystal dissipation to approximately one-half of the rated value of one milliwatt. The feedback also reduces the oscillator frequency pulling range, improves the frequency stability, and helps maintain a more constant output level with component aging and power supply variation. The output of the Reference Oscillator is applied to the Solid-State Switch. The Solid-State Switch is a semiconductor, electronically operated switch which accepts input levels up to +14 dbm and transmits this signal with less than 1 db insertion loss when it is "on" and rejects the carrier by more than 70 db when it is "off".

Capacitors C_1, C_2 and C_3 serve as AC coupling capacitors, while capacitors C13 and C14 short circuit any AC at bias terminals (Plugs P1, 8 and 11) to ground. The radio frequency chokes present a high impedance to any RF input signal. With bias terminal (P1-8) positive and bias terminal (P1-11) negative, the switch is in the "on" position; that is, the switch is in the low impedance state between jacks J1 and J2. With the bias in the "on" condition, diodes CR2 and CR3 are forward biased and in the low impedance state. Diodes CR1 and CR4 are reverse biased and, therefore, are in the high impedance state. The AC signal then flows from jack J1 to jack J2 with very little resistance; therefore, low insertion loss results. With the bias in this condition, the other half of the switch (jacks J3 to J2) is in the high impedance state and therefore contributes nothing to the circuitry. With bias terminal (P1-8) negative and bias terminal (P1-11) positive, diodes CR_2 and CR_3 become reverse biased; therefore, becoming high impedances. Diode CR_4 becomes forward biased, shorting any stray AC signal at the junction of diodes CR_2 and CR_3 to ground. Diode CR_1 also becomes forward biased, terminating jack J1 into a resistive 50 ohms. The switch now has an insertion loss of greater than -70 db. Jack J2, looking at diode CR_4, sees a high impedance, and the jacks J1 to J2 switch is open. However, in the later biased condition, the signal path from jack J3 to J2 reverts into a low impedance path resulting in transmission from jacks J3 to J2. The jacks J3 to J2 portion of the switch is identical to the jacks J1 to J2 portion of the circuit, with the exception of a reversal in bias terminals.

c. Compressor-Limiter

The Compressor-Limiter is an all solid-state unit which serves to compress and limit the incoming IF Signal. An IF signal of 50.25 mc, at a nominal level of 5 mv is applied to the Compressor-Limiter at jack J1 from the Solid-State Switch. This signal is amplified and compressed in three identical compressor stages; Q1, Q2 and Q3. Amplitude compression is achieved by two diodes, connected in opposite polarity, across each of the collector circuits. One diode conducts in each half of the signal cycle. Since the conduction characteristics of the diodes are not linear, signal compression is effected with high signal levels. The "Q" of each stage is thus determined by the input signal level. Limiting takes place when, as result of successive compression action, the mean signal level is above the self-bias point of the diodes, since the level cannot rise above that point. Interstage signal-voltage dividers are used to prevent overdriving the following amplifier. For in-service monitoring purposes, the signal level is sampled, rectified, and made available at the test points. The output of the Compressor-Limiter is applied to the Driver-Discriminator.

d. Driver-Discriminator

The AFC Driver-Discriminator amplifies and limits the output of the AFC Compressor-Limiter, then reduces it to a square wave. The square wave is at the same frequency as the Sampling Oscillator, with its amplitude proportional to the difference between the Reference Oscillator frequency and the average VCO frequency. The phase of the square wave is determined by whether the average VCO frequency is higher or lower than the Reference Oscillator frequency. The circuit input from the AFC Compressor-Limiter is composed of alternate Reference Oscillator and VCO pulses. The Discriminator output for the reference oscillator pulse is zero volts dc, since the Reference Oscillator is at the resonant frequency of 70-mc.

If the average VCO frequency is lower than 70 mc, the Discriminator output for the VCO pulse will be positive, with its amplitude proportional to the frequency difference between the average VCO signal and 70 mc. If the average VCO frequency is higher than 70 mc, the Discriminator output for the VCO pulse will be negative, with its amplitude determined in the same manner. Capacitor C20 removes the DC component, and the result is a square wave in which the positive portions are formed by either the VCO or the Reference Oscillator, depending on whether the VCO pulse output was positive or negative. Thus, the phase of the output square wave is dependent on whether the VCO frequency is higher or lower than the frequency of the Reference Oscillator. The output of the module is applied to the Error Amplifier for amplification and removal of the modulating signal from the VCO pulses. The two monitor outputs are applied to the Monitor Control for test.

e. Error Amplifier

The Error Amplifier removes the modulation from the VCO pulses and amplifies the 35-cps error signal from the AFC Driver-Discriminator. The output of the Error Amplifier is applied to the Chopper Demodulator as frequency correction.

Resistor R2 and capacitor C1 form a low-pass filter, removing the modulation from the input signal. The signal is then amplified by cascaded amplifiers Q1 through Q4, and applied to the base of emitter-follower Q5. Emitter-follower Q5 provides the proper impedance matching, and the amplified error signal is applied, through resistor R22, to the Chopper Demodulator. Variable resistor R14 in the base circuit of amplifier Q4 provides gain adjustment, but for normal operation the circuit is always set for maximum gain. A portion of the circuit output is applied to the Meter Module for monitoring by the front-panel meter on the Modulator.

f. Chopper Demodulator

The Chopper Demodulator also contains the Sampling Oscillator. The Sampling Oscillator is a multivibrator which produces two 35-cps square waves. Under control of these square waves, the Chopper Demodulator converts the error signal from the AFC Driver-Discriminator to either a negative or positive voltage, depending on its phase. This voltage is added to the VCO bias level and sent to the VCO Bias Control circuit as AFC bias. Transistors Q1 and Q2 form a free-running multivibrator with outputs of +18 vdc and +2 vdc. The conduction time of transistor Q2 is determined by the discharge time of capacitor C2 through resistors R8, R2 and R4, and the conduction time of transistor Q1 is determined by the discharge time of capacitor C5 through resistors R11, R12, R6 and R5. Variable resistor R5 adjusts the conduction time of Q1 to equal the conduction time of Q2. Each transistor conducts and then cuts off approximately 35 times per second, and the circuit output consists of two 35-cps square waves, 180 degrees out of phase. The square wave output of transistor Q1 is applied to the bases of parallel emitter-followers Q5 and Q6, and the output of transistor Q2 is applied to an identical circuit composed of emitter-followers Q3 and Q4. Both emitter outputs are applied to the AFC Solid-State Switch, and a portion of each is tapped off to gate chopper demodulator Q7 and Q8. A portion of the output of Q2 is applied to the Meter Amplifier and Detector to operate the meter-chopper circuit.

Transistors Q7 and Q8 are field effect transistors. As shown in figure 3-15, they act as switches, turned on and off by inputs from the Sampling Oscillator. A positive input from the Sampling Oscillator turns each transistor off, and a zero input turns it on. From time interval T1 to time interval T2, therefore, transistor Q7 is on and transistor Q8 is off (as shown). Between time interval T2 and time interval T3, the reverse is true. The error signal input to the chopper transformer is always in phase with one of the two sampling oscillator outputs, since these outputs were used to produce it. If the error signal is in phase with the Sampling Oscillator input to transistor Q8, and 180 degrees out of phase with the Sampling Oscillator input to transistor Q7, all circuit wave shapes are as shown in figure 3-12. Between time intervals T1 and T2, the positive error signal produces a negative pulse at the top of the chopper transformer secondary, and a positive pulse at the bottom. The bottom of the secondary is effectively out of the circuit due to the open at transistor Q8, but a return for the top of the secondary is provided by the center tap. Disregarding the VCO bias input, the voltage at the secondary's center tap between time intervals T1 and T2 is then one half of the voltage at the secondary, which is a negative pulse.

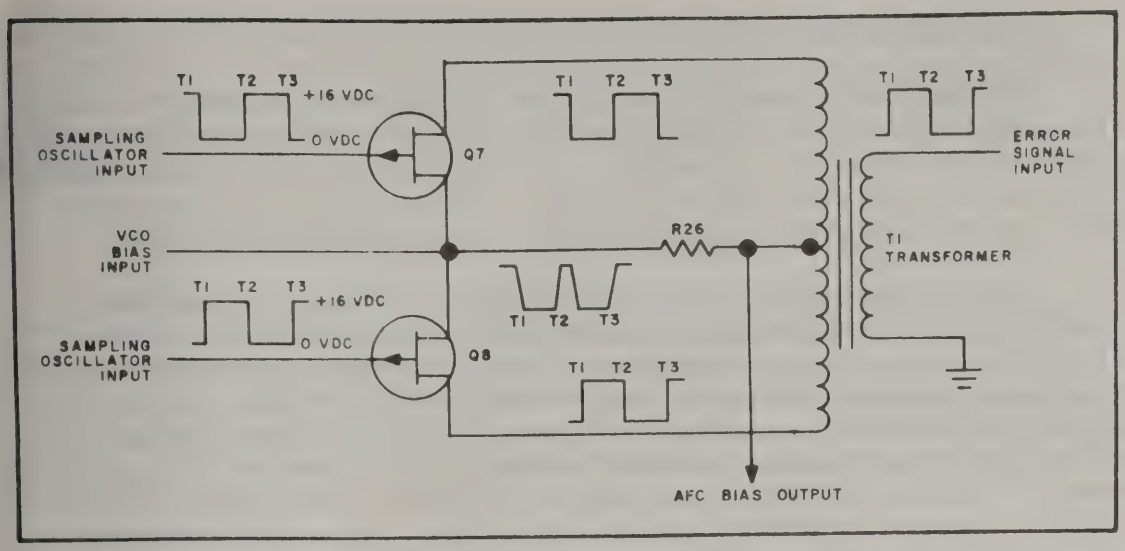


Figure 3-15. Chopper Demodulator, Simplified Schematic

Between time intervals T2 and T3, the negative pulse applied to transistor Q8 switches it on, and the positive pulse at transistor Q7 switches it off. The negative error pulse produces a positive pulse at the top of the transformer secondary, and a negative pulse at the bottom. Due to the open circuit at transistor Q7, the top of the secondary is out of the circuit, but the bottom has a return through the secondary's center tap. The voltage at the center tap is then one half of the voltage at the bottom of the secondary, which is a negative voltage. Thus, both the positive and negative swings of the error signal produce a negative voltage level.

If the error signal is in phase with the Sampling Oscillator input to transistor Q7, the circuit operates in the opposite manner. When transistor Q7 is "on" and transistor Q8 is "off", the negative error signal produces a positive pulse at the top of the transformer secondary. The bottom part of the secondary is open, and the voltage at the center tap is one half the positive voltage at the top of the secondary. In this manner, the Chopper Demodulator produces either a positive or negative DC voltage, depending on the phase of the input error signal. Whether positive or negative, the correction voltage is combined with the VCO bias level (+0.2 to 0.6 vdc) and the sum of the two levels is applied to the VCO bias control circuit as AFC bias.

In the actual circuit diodes CR3 and CR4 serve to limit the switching spikes caused by the field effect transistors. Resistors R21, R22 and R29 form a voltage divider between the VCO bias input and the sampling oscillator inputs. Variable resistor R29 is adjusted so that the AFC bias output equals the VCO bias input at a frequency of 70 mc.

8. Demodulator Transfer Circuit (Type 1130 Receiver only)

The Demodulator Transfer unit is a switching device, controlled by the level of DC control voltage, from the Noise Amplifier Reflex and Recorder Amplifier, to Schmitt-Trigger Q9 and Q10. Transistor Q9 controls the bias of baseband amplifiers Q1 and Q2, and order wire amplifiers Q5 and Q6, while transistor Q10 controls the bias of baseband amplifiers Q3 and Q4, and order wire amplifiers Q7 and Q8.

When the signal-to-noise ratio of the input is above threshold, amplifiers Q1 and Q2, and Q5 and Q6 conduct and the Receiver operates through the Wideband Demodulator. When the signal-to-noise ratio of the input signal drops below threshold the DC control voltage applied to the base of transistor Q10 increases, causing transistor Q10 to conduct. The output of transistor Q10 changes the bias at the bases of baseband amplifiers Q3 and Q4, and order wire amplifiers Q7 and Q8, causing them to conduct. When amplifier Q7 conducts, relay K1 becomes energized, and the Receiver operates through the Threshold Extension Demodulator. The output of the baseband amplifiers is fed to the Channel Capacity Selector and the output of the order wire amplifiers is fed directly to the Combiner.

Threshold Extension Defeat switch S4 (located on the Monitor Control) is used to defeat the Threshold Extension Demodulator of the Receiver, or to supply a fixed DC control voltage when it is under test. Setting switch S4 to DEFEAT applies the DC control voltage, ordinarily used to activate the Demodulator Transfer Circuit, to ground. This also completes the associated lamp circuit, allowing the lamp to go on. Setting the switch to TEST applies a constant -12 volts DC control voltage to the Demodulator Transfer Circuit. This constant voltage keeps the Receiver operating through the Threshold Extension Demodulator during testing or alignment. During normal Receiver operation, the switch should be set to NORMAL.

9. Channel Capacity Selector (72, 132, and 252 Channels)

The Channel Capacity Selector consists of a Deemphasis Circuit and a Threshold Extension Frequency Equalizer. The Deemphasis Circuit is a unity-gain device employing an integrating circuit with a response of 6 db per octave. The Frequency Equalizer compensates for the increase in response generated in the feedback loop of the Wideband Amplifier in the Threshold Extension Demodulator.

The Frequency Equalizer consists of resistors R16, R17 and R18 and capacitor C12 for 72 channels; and resistors R22 and R23 and capacitor C19 for 132 channels. Potentiometer R18 (72 channels) or R23 (132 channels) is used to adjust the frequency response. The frequency equalizer is not used in Type 1130A Receiver.

The Deemphasis Circuit receives a baseband signal from the Demodulator Transfer Circuit. The high impedance input is isolated from the low impedance deemphasis network by emitter follower Q1-Q2. The deemphasis network for 72 channels consists of resistor R11, potentiometer R14, and capacitor C10. Poteniometer R14 is used to adjust the high end of the baseband frequency response. The

deemphasis network for 132 channels consists of resistor R10, potentiometer R11, and capacitor C10. Potentiometer R11 is used to adjust the high end of the baseband frequency response. Emitter follower Q3 is used in the output to isolate the high impedance of the deemphasis network from the low input impedance of the Receiver Combiner.

10. Receiver Combiner Circuit

The Receiver Combiner consists of separate Baseband and Order Wire Combiners. They are used to combine signals from two or more Receivers in such a fashion as to always present the best signal-to-noise ratio. The Combiners are cascode type emitter follower circuits. The emitter of one combiner element is connected to the emitter of a second combiner element located on another Receiver in diversity operation. The Combiner Recorder output is used to monitor the emitter voltage of the baseband combiner which in turn monitors diversity Receiver operation.

Both the Baseband and Order Wire Combiners are operated in a cascode transistor-on-transistor type arrangement, the common junction between the emitter of the one transistor (Q1, Q3) to the collector of the other (Q2, Q4) is connected to the Combiner of the other Receiver in diversity operation. The base of the one transistor (Q1, Q3) is driven by the DC control voltage, which is inversely proportional to the RF signal strength. For poor RF signals, larger DC control voltages are generated. As the RF signal increases, the DC control voltage is proportionately reduced. In diversity operation, due to the differential voltages appearing at the combiner base, the base signal-to-noise ratio is selected.

For simplicity, this description is for the dual diversity operation. Triple or quadruple diversity will operate under the same principle in both the Baseband and Order Wire Combiner circuits. When the difference between two RF signals is 6 db or greater, and the slope of the DC control voltage is 0.7 volts per octave change of the RF signal; the DC differential voltage of the base will eventually cut off one of the combiner bases. When the differential voltages exceeds 0.7 to 0.8 volts; in other words, the differential RF signal exceeds 6 db, the branch controlled by this particular Receiver Combiner has been eliminated. Since all the Receiver characteristics are identical and symmetrical frequency response, phase and amplitude are identical; when the RF signal strength is equal, the differential voltage between the bases is zero. Due to the common emitter loading there is unity gain as far as the signal is concerned, but the noise adds in an RMS fashion, and an effective noise reduction exists. Assume a baseband signal-to-noise ratio is 40 db;

$\text{Receiver}_1\ S/N = 10^4$ or 40 db $\qquad$ $\text{Receiver}_2\ S/N = 10^4$ or 40 db

$$S/N_1 + S/N_2 = 10^4 + 10^4 = 2 \times 10^4 = 10 \log 2 \times 10^4 = 43 \text{ db}$$

If all Receiver Combiners distribute equally, a 3 db improvement in signal-to-noise ratio for dual diversity is obtained. The baseband output is fed through the Output Attenuator (part of Monitor Control) to the Baseband Amplifier. The order wire output is fed to the Order Wire Amplifier.

A recorder circuit is provided to monitor the emitter voltage of the baseband combiner, which in turn monitors the diversity Receiver operation. Potentiometers R27 and R25 are used to adjust the zero setting and the full scale defection of the recorder respectively. Combiner Defeat switch S1, disables the combining circuits. Setting the switch to DEFEAT, terminates each of these circuits into an open circuit allowing the Receiver to operate as an elementary Receiver. In the defeat position, this switch also completes the associated lamp circuit, allowing the lamp to go on.

11. Baseband Amplifier

The Baseband Amplifier is a broadband feedback amplifier with 20 db of closed loop gain and an output impedance of 75 ohms. It has a frequency response of ±0.2 db from 8 kc to 1052 kc. The baseband input is fed from the Receiver Combiner through the Output Attenuator. A Gain potentiometer R19, is located in the feedback loop and is used to adjust the output level. Phase correction is introduced by a phase correction network consisting of capacitor C9 and resistor R8 which improves the phase margin of the unit. The dual emitter-follower output stage consists of two parallel transistors, Q4 and Q5 which develop the power dissipation necessary for driving a 75-ohm load. When the amplifier is terminated in 75 ohms, there is a loss in gain of 6 db. The output to the Alarm Amplifier is taken prior to this loss in gain.

12. Alarm Amplifier

The Alarm Amplifier causes Baseband Fault Indicator DS10 to go on when the Baseband Amplifier fails. Connections are available to extend the fault alarm to an external Fault Indicator. The input provides isolation from the Baseband Amplifier by means of a voltage divider consisting of resistors R1 and R3. This is necessary to prevent any reflections back to the Baseband Amplifier. The input signal is amplified in transistors Q1 and Q2, which comprises a two-stage feedback amplifier. Under normal signal levels, the voltage doubler, consisting of capacitors C7 and C11, and diodes CR1 and CR2, develops the positive DC voltage on the base of transistor Q3. This voltage drives the transistor into conduction, energizing relay K1. Diode CR3, (across the relay coil) suppresses any transients developed, when the relay goes from an energized to a deenergized state. Capacitor C13 reduces any low frequency ripple which might appear on the relay coil. The gain of the unit is set so that the pilot signal, 13 db below the normal baseband test tone, cuts off transistor Q3 and causes the relay to deenergize and the alarm circuits to operate.

13. Order Wire Amplifier

The Order Wire Amplifier provides a nominal gain of 34 db to maintain an output of -15 dbm into 600 ohms. It has a frequency response of ±0.5 db from 250 cps to 12 kc. Gain potentiometer R4 is provided to adjust the output level to the system requirements.

Input signals are applied to the Order Wire Amplifier from the Receiver Combiner. The Order Wire Amplifier is a two stage feedback amplifier with an emitter-follower output stage feeding an output transformer. The amplifier provides a nominal closed loop gain of 38 db which can be adjusted to within ±2 db of the nominal required value by means of Gain potentiometer R4. Stability and linearity are achieved with approximately 20 db of negative feedback. Emitter-follower Q3 provides proper isolation between output transformer T1 and Amplifier Q2. The 1:1 output transformer establishes a balanced output from the Order Wire Amplifier. Capacitor C1 removes any baseband signals which may get into the order wire channel.

14. Noise Amplifier Circuits

a. General

The Noise Amplifier circuits (figure 3-16) are used to provide a DC control voltage for the Receiver Combiner. The noise output of the Distribution Amplifier

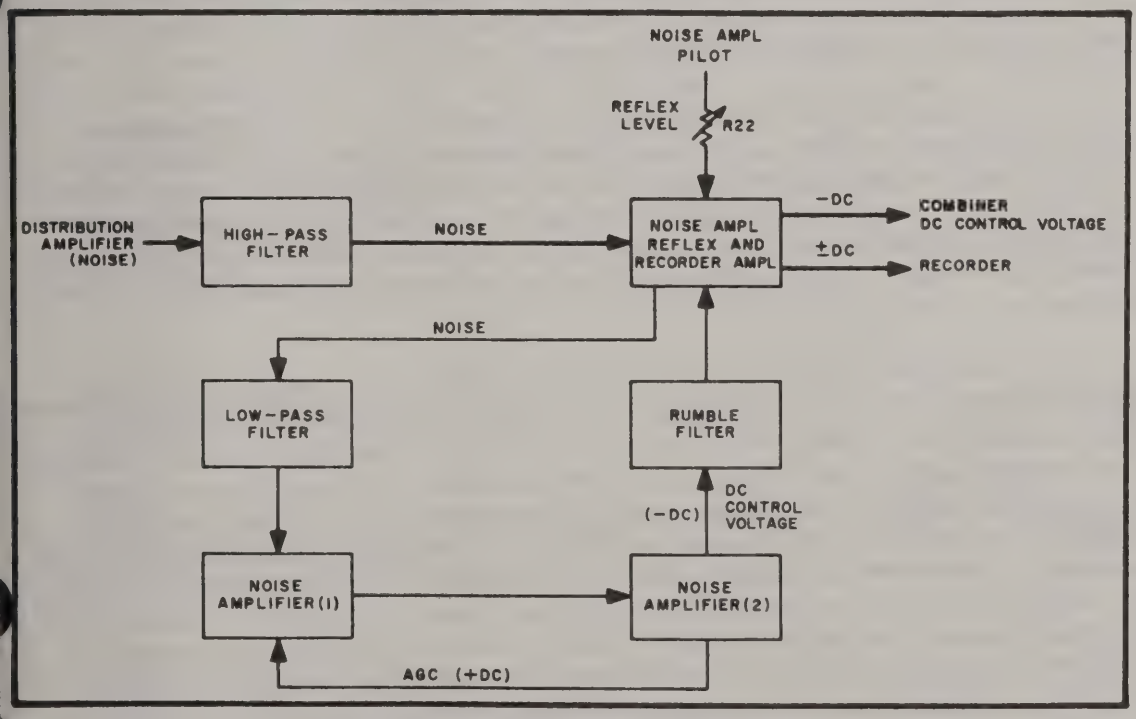


Figure 3-16. Noise Amplifier Circuits

is out-of-band noise. This out-of-band noise is filtered by means of a High-Pass Filter with a cutoff frequency dependent on the channel capacity. The cutoff frequency is at least three times away from the highest modulation frequency. After filtering, the out-of-band noise is amplified in the Noise Amplifier Reflex and Recorder Amplifier, Noise Amplifier (1), and Noise Amplifier (2) in logarithimic fashion. The signal is then applied to a 3.5-kc Rumble Filter to remove all high frequency rumble. The output of a Rumble Filter is then applied to the Noise Amplifier Reflex and Recorder Amplifier. This unit provides a DC output for use with a 1500 ohm, 1 ma Recorder (not part of the Receiver). The main output of the Noise Amplifier Reflex and Recorder Amplifier is the rectified out-of-band noise, which in DC form, provides the DC control voltage for the Demodulator Transfer circuit and the Receiver Combiner. The Noise Amplifier Reflex also provides a Noise Amplifier Pilot Alarm feautre whereby failure of the Noise Amplifier circuits automatically takes the Receiver out of service.

b. Noise Amplifier Reflex and Recorder Amplifier

The Noise Amplifier Reflex and Recorder Amplifier contains a transistor amplifier which accepts the out-of-band noise and a portion of the pilot signal. The Noise Amplifier Pilot Reflex circuit operates in conjunction with the Pilot Amplifier, to provide a visual indication of Noise Amplifier operation. When the Noise Amplifier becomes inoperative, the Noise Amplifier Pilot Reflex circuit becomes deactivated and the associated Receiver audio signal is removed from the system. This is indicated by means of an external visual alarm. A Noise Amplifier Recorder circuit is used to monitor the RF signal strength. It is driven by the DC control voltage and is an inverse logarithmic function of the RF signal.

The amplifier (Q1 and Q6) is used to provide linear gain and impedance match to the Noise Amplifier Low-Pass Filter. The Low-Pass Filter is used to remove the high frequency noise components so that only the correlated out-of-band noise will be applied to the Noise Amplifier Circuits. A portion of the radio pilot signal is injected into the emitter of transistor Q1 and is amplified along with the out-of-band noise which is applied to this amplifier at the base of the transistor Q1. This amplifier has a voltage gain of approximately 20 db.

The Noise Amplifier Pilot Reflex Circuit is used to disable the Receiver Combiner and provides a visual indication of failure of the noise amplifier circuit. Noise Amplifier Pilot defeat switch S3 which is mounted on the Monitor Control Module, is used to disable the relay circuit. The defeat condition is indicated by an external lamp. Noise Amplifier Pilot Defeat switch S3 is used to manually defeat the Noise Amplifier Pilot reflex circuit. Setting switch S3 to DEFEAT, grounds the collector of transistor Q3, on the Noise Amplifier Reflex and Recorder Amplifier, through resistor R10. With resistor R10 as the load resistor of the circuit, the output of transistor Q3 is applied to ground and reflex relays K1 and K2 remain deenergized, allowing the Receiver to function normally. As the radio pilot is applied to the Noise Amplifier with the out-of-band noise, the DC control voltage is set to -1.5 volts dc by adjusting Pilot Reflex Level potentiometer R22. Pilot Reflex potentiometer R7 is adjusted so

that the reflex relays are energized. A component failure in the Noise Amplifier Circuit which causes the DC control voltage to fall below -1.5 volts dc, will deenergize the relay circuit, which in turn will disable the Receiver Combiner.

A Recorder Amplifier is provided to indicate the received RF signal strength, as a function of DC control voltage. Since the DC control voltage is inversely proportional to the RF signal, the weaker the RF signal the greater the Recorder output. Potentiometers R13 and R15 are used to adjust the zero setting and the full scale defection of the Recorder respectively. The output of amplifier Q1-Q6 is applied through the Low-Pass Filter, to Noise Amplifier (1).

c. Noise Amplifier (1)

Noise Amplifier (1) is a logarithmic video amplifier operating in a range of 50 kc to 7 mc. This amplifier in conjunction with Noise Amplifier (2) provides amplification for the out-of-band noise and rectification of this noise to act as DC control voltage for the Receiver Combiner.

In the Noise Amplifier circuit, the output of the Low-Pass Filter is applied to three series-connected tetrode transistors (figure 3-17). The tetrode transistor has a second base. It is attached to the opposite side of the base region from the first base. A transverse bias is applied to the second base, which controls the effective collector area and therefore, the Beta of the transistor. In conjunction with the second base, the emitter bias can be varied to compensate for the AC parameter changes other than Beta. The signal is applied to the first base, and an increase in signal will result in a higher positive AGC voltage. This voltage is then applied to the second base resulting in a gain reduction proportional to the input signal. The output of the third tetrode transistor (Q3) is applied to the first feedback amplifier consisting of three transistors (Q4-Q6). This feedback amplifier has 30 db of gain and 15 db of feedback at 500 kc. The output of this amplifier is applied to another AGC controlled tetrode transistor stage (Q7), which is followed by a second feedback amplifier (Q8-Q10). The second feedback amplifier is identical to the first feedback amplifier. The output of Noise Amplifier (1) is applied to Noise Amplifier (2).

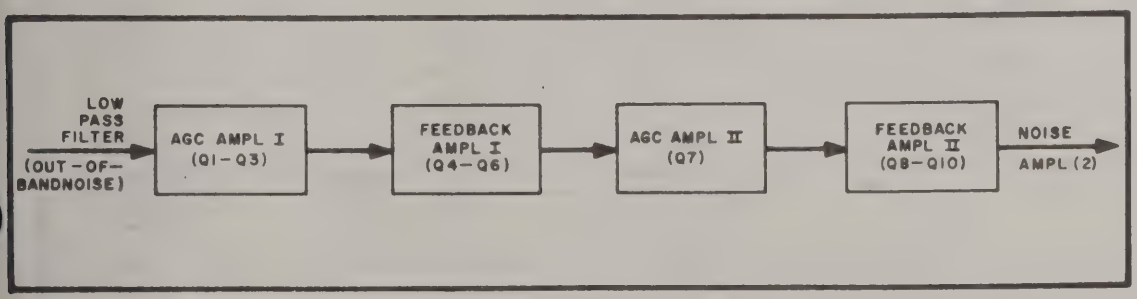


Figure 3-17. Noise Amplifier (1)

d. Noise Amplifier (2)

Noise Amplifier (2) (figure 3-18) is a video amplifier operating in a range of 50 kc to 7 mc. This amplifier, in conjunction with Noise Amplifier (1), provides amplification for the out-of-band noise and rectification of this noise to act as a DC control voltage for the Receiver Combiner.

In the Noise Amplifier circuit the output of Noise Amplifier (1) is fed to the feedback amplifier consisting of transistors Q1-Q2. It has a gain of 29 db and 18 db of feedback of 500 kc. The output of this amplifier is applied through an emitter-follower (Q3-Q4) to two voltage doublers each consisting of two diodes CR1-2 and CR3-4. The output of the positive doubler is fed back through the emitter-follower to the second base of the tetrodes located on Noise Amplifier (1). Potentiometer R15, at the input of this doubler, is used to adjust the amount of the feedback voltage and in turn, controls the slope of the DC control voltage. The output of the negative doubler is DC control voltage, which is fed through an emitter-follower to the Rumble Filter. The Rumble Filter is used to remove any undesired noise. In conjunction with Noise Amplifier (1), the DC control voltage output is log-linear and is inversely proportional to the received RF signal, which decreases approximately 0.7 volts dc per octave with an increase in the received RF signal.

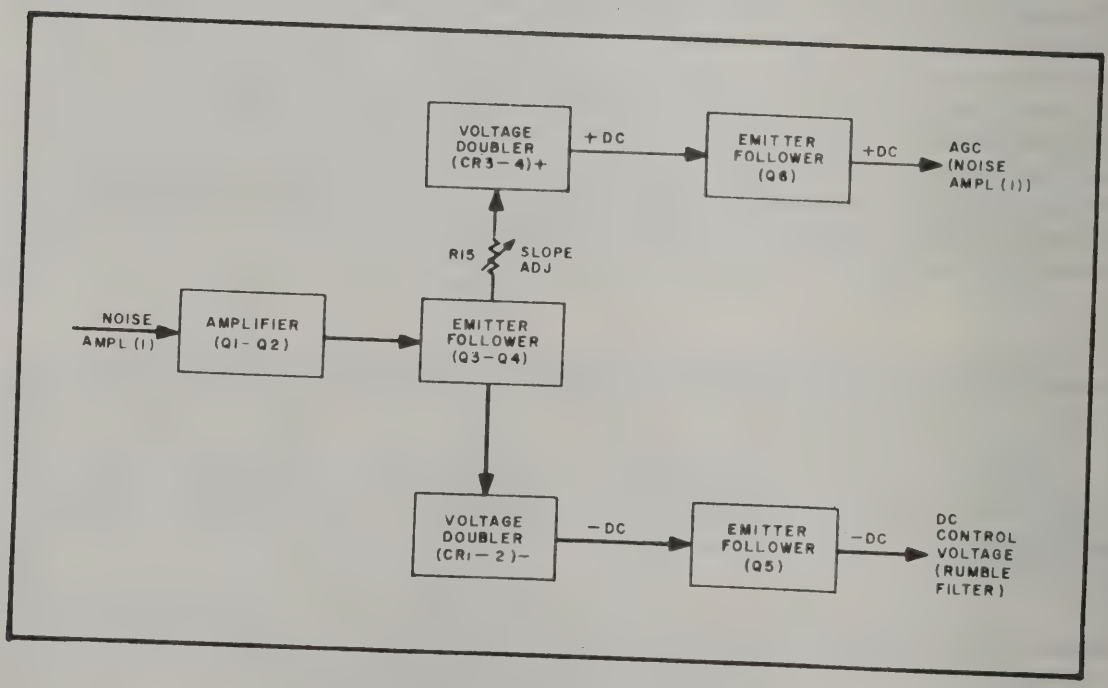


Figure 3-18. Noise Amplifier (2)

15. Radio Pilot Circuits

a. General

The Radio Pilot Circuit is shown in figure 3-19. The radio pilot signal level which is 10 db below the baseband test tone level, is applied through amplifier Q1 to the Pilot Filter and then the Pilot Crystal Filter. This combination rejects noise as well as recovered modulation, so that it will not be amplified in the absence of the pilot signal. The output of the Pilot Crystal Filter is applied to the first feedback amplifier consisting of transistors Q2 and Q3 which has a voltage gain of 33 db with an AC feedback of approximately 15 db at the pilot frequency. The second feedback amplifier consisting of transistors Q4, Q5 and Q6 is similar except its output stage is an emitter-follower. The emitter-follower provides a low output impedance to the voltage doubler consisting of diodes CR2 and CR3. The rectified radio pilot signal is used as a control for the trigger circuit. During calibration, in the absence of the radio pilot signal, Pilot Reflex Adjust potentiometer R32 is set to cut off transistor Q7. When Q7 is cut off, transistor Q8 conducts, and transistor Q9 is cut off. This causes alarm relays K1 and K2 to be deenergized. With the presence of a pilot tone signal, a higher voltage appears at the base of transistor Q7 and causes the transistor to conduct. The increase in current through resistor R34 causes a decrease in base voltage at transistor Q8. This causes transistor Q8 to be cut off. With transistor Q8 cut off, less current passes through resistor R40. This in turn, raises the base voltage on transistor Q9, and causes Q9 to conduct and alarm relays K1 and K2 to energize. The above process is reversed, in the absence of the radio pilot signal, and causes the alarm relays to deenergize.

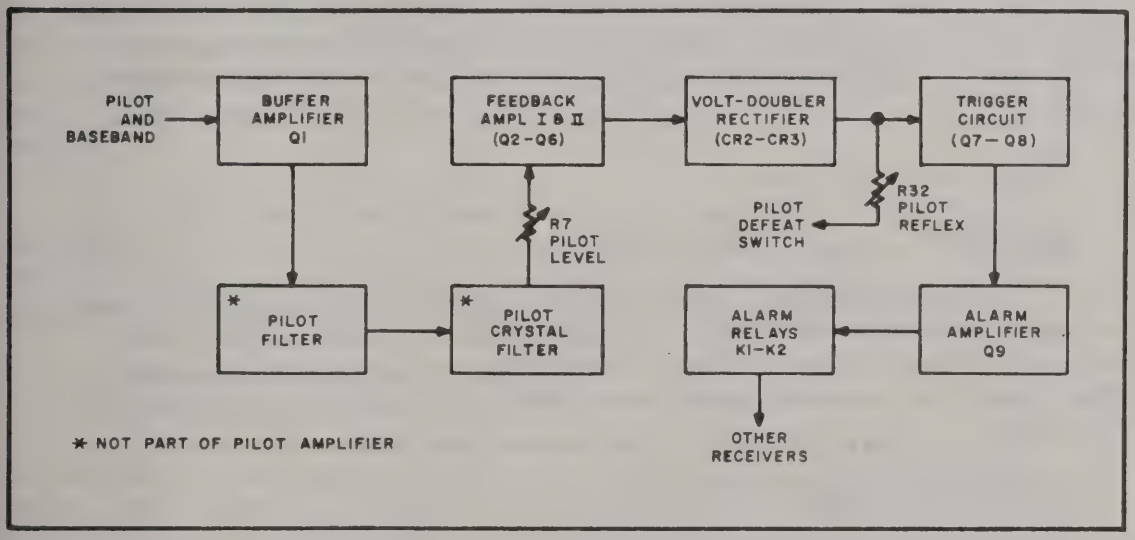


Figure 3-19. Pilot Amplifier and Reflex Circuit

b. Pilot Alarm and Interlock Circuit

For simplicity, the description which follows is for dual diversity operatio Triple or quadruple diversity operate under the same general principles. When the radio pilot signal is present at the output of the Pilot Amplifier voltage doubler of both Receivers, alarm relays K1 and K2 energize. The energized relays deactivate the external visual and aural alarm circuits. When the radio pilot signal in one Receiver, drops to 3 db below the normal radio pilot level, transistor Q9 in the Pilot Amplifier of that Receiver cuts off, deenergizing alarm relay K1. This in turn activates the associated external alarm circuit and the visual indicator on the front panel. Alarm relay K2 remains energized because it is directly connected via the pilot interlock connec tion to the other Receiver, which is functioning normally. Alarm relay K1 and transistor Q9 in the other Receiver provide the return path for alarm relay K2. While the Combiner of Receiver (1) is cut off through the complete path provided by the contacts of alarm relay K2 (pin 4). The cutoff voltage for the Receiver Combiner Circuit is derived through diode CR4. When the radio pilot is lost in both Receivers, alarm relay K2 deenergizes and removes the Receiver Combiner Circuit cutoff voltage. This causes the Receiver Combiner to function normally.

Radio Pilot Defeat switch S2 is used to manually defeat the pilot alarms and Receiver Combiner cut-off circuits, allowing the Receiver to operate normally when it is under test or when the radio pilot signal has been lost. Setting switch S2 to DEFEAT, places a ground between Pilot Reflex Adj potentiometer R32 and resistor R33 on the Pilot Amplifier, effectively removing resistor R33 from the circuit. This decreases the resistance of this circuit by approximately two-thirds of its normal value. The resultant increase in level at the base of transistor Q7 maintains it in a constant state of conduction. When transistor Q7 is conducting, transistor Q8 is cut off. Since no voltage is developed across collector load resistors R39 and R40; relay amplifier Q9 is forward biased. Relay amplifier Q9 continues to conduct. Alarm relays K1 and K2 remain energized, allowing the Receiver to continue fucntioning normally.

16. Monitoring and Metering

a. General

The monitoring and metering circuits are shown in figure 3-20. AC and DC voltages and Currents throughout the Demodulator are extended to the Monitor Control or the Function Selector Switch. Those terminating in test points in the Monitor Control are connected to the Function Selector Switch by use of the built-in Test Probes.

b. Monitor Control

The Monitor Control consists of Test Points, Test Probes, Defeat Switches, and a Baseband Attenuator. All test points are located on the left side of the unit. They are provided to check the operation of the various circuits of the Demodulator by

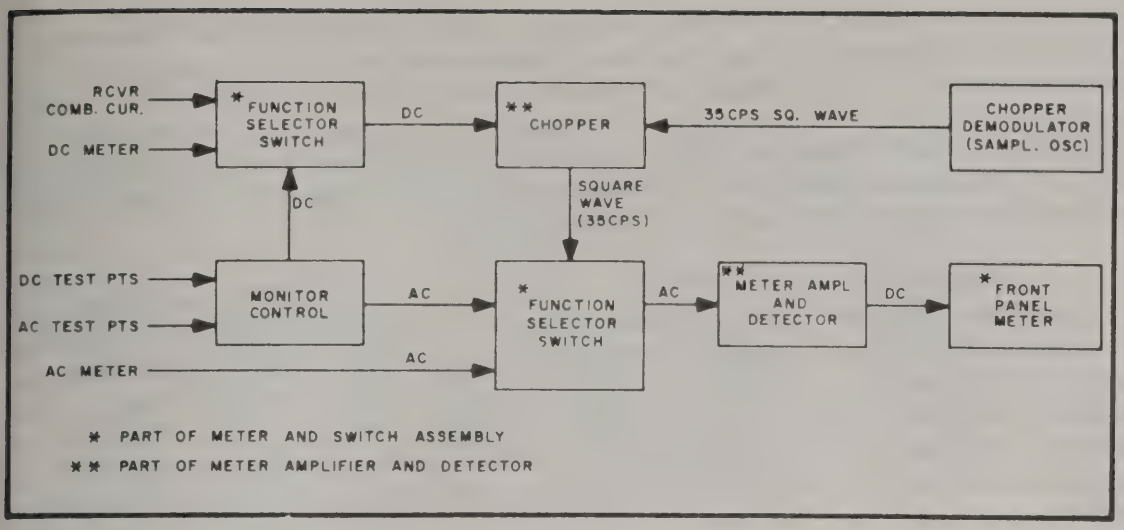


Figure 3-20. Monitoring and Metering Circuits

using the front-panel meter. Each test point samples the output of a circuit and attenuates the output of a proper level for the front-panel meter.

There are four defeat switches; Radio Pilot switch S1, Combiner switch S2, Noise Amplifier Pilot switch S3, and Threshold Extension switch S4. The Radio Pilot and Noise Amplifier Pilot defeat switches are used to defeat the respective switching circuits in event of loss of the pilot tone signal under the normal Receiver operation. The Combiner defeat switch is used to disconnect the combiner circuit so the Receiver will operate as an elementary receiver. The Threshold Extension defeat switch is used to defeat the Threshold Extension portion of the Receiver. Each of the above actions is indicated by individual defeat lamps which are mounted on the front panel. Under normal Receiver operation, all defeat switches are placed on the normal position.

The Baseband Level Attenuator is a 1-db step attenuator with a total variation of 8 db. The low impedance output of the baseband combiner is fed to the input of the attenuator and the output is fed to the Baseband Amplifier. The attenuator provides a high input impedance of approximately 500 ohms.

c. Meter Amplifier and Detector

The Meter Amplifier and Detector amplifies AC test signals and then detects the amplified signals to prodice a DC level for display on the front-panel meter. The meter chopper circuit (in the Meter Amplifier and Detector) converts DC test voltages to square waves for input to the Meter Amplifier. Chopper transistor Q6 (a field effect transistor) is controlled by a 35-cps square wave from the Sampling Oscillator in the Chopper Demodulator. In this circuit, transistor Q6 operates as a

simple "on-off" switch. On the positive portion of the controlling signal transistor Q6 is "off," and presents a high impedance between pins 16 and 10 of plug P1. On the negative portion of the square wave transistor Q6 conducts. Because of the isolating effect of resistor R27, the output of the negative half cycle of the control signal is the voltage at the DC balanced input. The output of the Chopper Demodulator is therefore a 35-cps square wave, with a peak-to-peak amplitude equal to the potential difference between the DC input and the DC balanced input.

The DC output of the Chopper Demodulator is connected through Meter Function Select Switch S1 back to the audio input on the Meter Amplifier and Detector. The square wave signal is coupled through capacitor C1 and amplified by cascaded amplifiers Q1 and Q2. The collector output of transistor Q2 is coupled through capacitor C7 to the limiting circuit formed by diodes CR2 and CR3. The signal is derived across the forward impedance of one of the diodes (depending on the instantaneous signal polarity). Limiting action (which prevents the meter from being overdriven) takes place when the signal amplitude rises above the breakdown point of the diode.

The limited signal is applied to the base of amplifier Q3, and the output from the collector of amplifier Q3 is fed to the cascode emitter-follower circuit formed by transistors Q4 and Q5. A cascode emitter-follower has unit gain and an extremely low output impedance. The output of transistors Q4 and Q5 is applied to the meter detection circuit. The front-panel meter, is adjusted in series with a dropping resistor across a balanced bridge circuit. The bridge circuit, composed of diodes CR4 through CR7 and resistors R22 through R26, is balanced by Zero Adjust potentiometer R24. The positive voltage applied to the movable arm of resistor R24 causes equal current flow through each side of the bridge, so that with no signal applied the voltage at pins 2 and 4 of plug P1 is equal, and the meter indication is zero.

Capacitors C13, C14 and C16, and diodes CR4 and CR5, form a half-wave voltage-doubler and detector circuit. The input square wave from transistors Q4 and Q5 is changed by this circuit to a negative DC voltage across capacitor C16 at approximately twice the value of the negative peak of the square wave. This causes an inbalance in the bridge circuit, and current flows through resistor R30 and the front-panel meter, causing the meter to indicate.

d. Meter and Switch Assembly

The Meter and Switch Assembly basically consists of the front-panel meter and Meter Function Select Switch S1. The four-deck, 12-position switch connects various Demodulator test points to the meter, routing them through resistance circuits which reduces all indications to a value within the limits of the meter scale. Thus, if the monitored voltages are at the correct level they will indicate within the proper tolerance on the meter, regardless of any difference in their actual value. Meter DC Sensitivity potentiometer R21 is used to calibrate the meter for all DC voltages, and potentiometer R15 is used to calibrate the AFC test levels. Inductors L1 and L2 and capacitors C2 and C3 filter out amplitude variations in the AFC test levels.

G. POWER SUPPLY-BLOWER

1. General

The Power Supply-Blower (figure 3-21) is a solid state unit which provides the low DC operating and AC oven heating voltages to the solid state components of the Receiver. It contains positive and negative 24- and 12-volt outputs regulated within ±0.1% at a nominal load capability of 1 amp each, as well as a 24-volt AC oven voltage at a load capability of 4 amps. The Power Supply-Blower consists of three basic circuits, a positive rectifier and regulator circuit, a negative rectifier and regulator circuit and the oven supply circuit. The Power Supply-Blower also contains a centrifugal blower to supply forced-air cooling to all points of the Receiver. A metering circuit is included in the Power Supply to provide a means of self testing the drawer. Remote load sensing is provided for the +24 volt and -24 volt sections of the Power Supply-Blower. Refer to the schematic diagrams for the Power Supply-Blower and Regulator cards.

Main power to the Power Supply-Blower is applied through circuit breaker CB1 to oven transformer T3 and blower circuit breaker CB2. Oven transformer T3 is protected by fuse F1 in series with the primary winding. The centrifugal blower is equipped with an air duct to direct the airflow to areas subjected to a high temperature

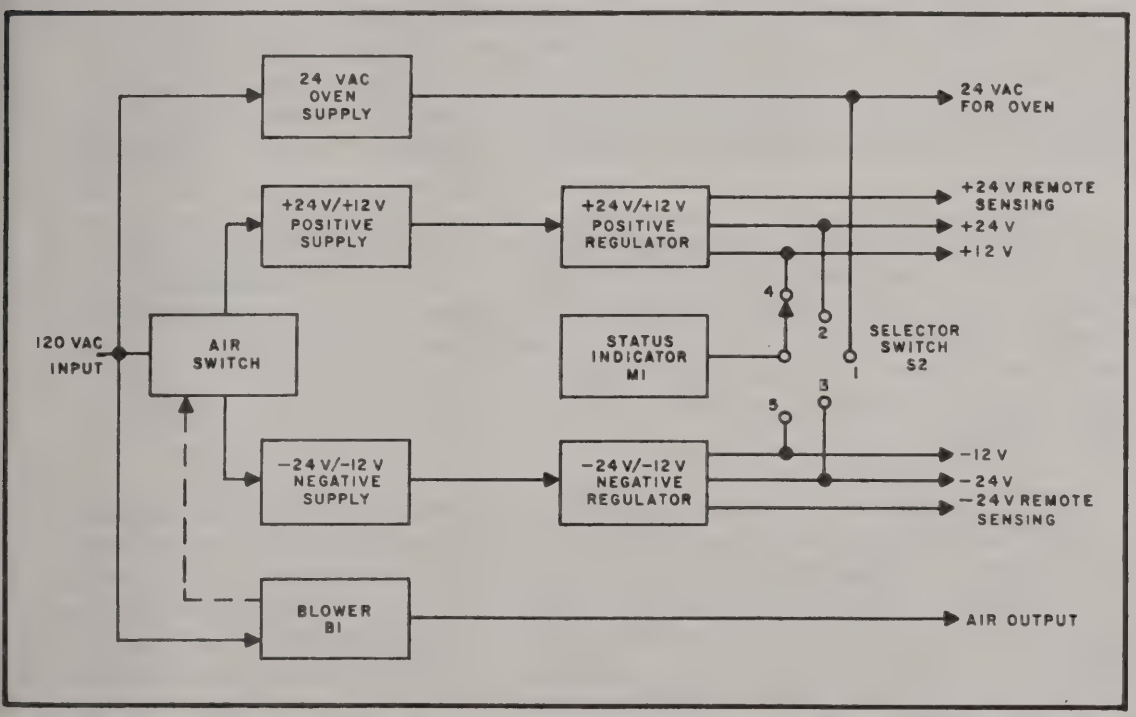


Figure 3-21. Power Supply-Blower, Simplified Block Diagram

increase, and ducts the major portion of the airflow out of the drawer to cool components of associated equipment in the Housing. An airflow switch in the primary circuit of the positive and negative power supply sections insures airflow before the Power Supply-Blower can be energized.

The main power circuit breaker and the blower circuit breaker protect the Power Supply and Blower from current overloads. Individual circuit breakers in the primary circuit of the positive and negative power supply sections will remove power from either circuit if a short occurs or the voltage becomes excessive. An inoperative blower will cause the blower airflow switch to open, thereby removing input power from both the positive and negative regulators.

Both transformers T1 and T2 are protected with magnetically operated circuit breakers, CB3 and CB4. These circuit breakers are of the two-pole type of construction. One of the poles senses the primary current of the transformer and thus opens the circuit breaker in the event of a rectifier-diode short or a shorted filter capacitor. The second pole in each of these breakers is activated by the over-voltage or over-current circuits located in the plug-in regulator cards. Circuit breakers CB3 and CB4 are wired so that both circuit breakers must be in a closed position in order for either the positive or negative power supplies to receive AC line voltage. This eliminates the possibility of having positive voltages applied to the solid state devices in the system while the negative voltage is not present.

Transformer T1 and the associated bridge rectifier, supply voltage to the positive series transistors. The +24-volt series transistor and the +12-volt series transistor are controlled by the Positive Regulator printed circuit card. Sampling of the +24-volt and the +12-volt output is accomplished by potentiometers R3 and R6. This sampled voltage is fed back to the differential amplifiers located on the Positive Regulator card.

Transformer T2 and its associated bridge rectifier, supply voltage to the negative 24 volt series transistor Q3 and the negative 12 volt series transistor Q4. Both the -24-volt series transistor and the -12-volt shunt transistor are controlled by the Negative Regulator printed circuit card. Sampling and adjustment of the -24-volt and the -12-volt output is accomplished through potentiometers R14 and R10. This sampled voltage is fed back to the differential amplifiers located on the Negative Regulator card.

Output voltage monitoring is accomplished by status indicator meter M1 and its associated multiplier-resistors. Switch S1 selects one of the five output voltages to be monitored. Potentiometers R17 (24V Meter Cal) and R19 (12V Meter Cal) are factory adjusted to calibrate the metering circuits. The multipliers and calibrate potentiometers are factory adjusted to better than 1% and readjustment is not recommended unless accurate instrumentation is available. Remote load sensing is provided for the +24 and -24 volt sections of the power supply. This sensing voltage must be connected or else the regulator voltage will be too high and cause tripping of the circuit breaker due to an over-voltage condition.

2. Positive Power Supply Section

The 120 volt AC input voltage is applied from MAIN POWER circuit breaker CB1, through BLOWER circuit breaker CB2, airswitch S1 and +24V/+12V circuit breaker CB3 to power supply transformer T1, which has two secondary windings.

One winding of transformer T1 applies a nominal 26 volt AC input to the bridge rectifiers, which provide a 33.5 volt DC output for the series transistors and regulator circuits on the positive regulator. The regulated +24-volt output is applied to series transistor Q2, which reduces this voltage to obtain the +12-volt output. A portion of the +24-volt output is sampled by means of a voltage divider, consisting of resistors R2 and R4, and potentiometer R3, and is applied to the positive regulator. The positive regulator contains the control circuitry which drives the series transistors of both the +24-volt and +12-volt sections of the positive power supply. The regulated +24- and +12-volt outputs are calibrated by +24V VOLT ADJ and +12V VOLT ADJ potentiometers R3 and R6, respectively.

The second winding of transformer T1 applies 13.6 volt AC to the positive regulator to provide input power for an auxiliary regulated supply.

3. Positive Regulator

The 13.6 volt AC input from the power supply is applied to the bridge rectifier circuit, diodes CR1 through CR4, and to zener diodes CR5 (12 volts) and CR6 (9.1 volts), which provide a preregulated source of DC voltage for the differential amplifiers. The +24-volt sample voltage from the voltage divider in the positive power supply is applied to transistor Q5 of the first differential amplifier, consisting of transistors Q5 and Q6. Transistor Q6 is voltage stabilized by temperature-compensated reference zener diode CR8 (11.7 volts). Directly coupled to transistor Q5 and Q6 is the second differential amplifier, consisting of transistors Q3 and Q4. Any potential change between the sampled output voltage and reference zener diode CR8 is reflected as a change in the collector current of transistor Q5, and consequently Q3, and is amplified by transistors Q2 and Q1. Transistor Q1 is directly coupled to the base of series transistor Q1 in the positive power supply; the dynamic impedance of series transistor Q1 varies, resulting in a change in output voltage of the supply.

The +12-volt regulator is essentially the same as the +24-volt regulator, with the exception that only one differential amplifier, consisting of transistors Q9 and Q10, is used. Zener diode CR10 (6.2 volts) is the reference element. Directly coupled to the differential amplifier are current amplifiers Q7 and Q8. Transistor Q7 drives series transistor Q2 in the positive power supply. Series transistor Q2 receives its input voltage from the previously regulated +24-volt bus and reduces this voltage to a regulated +12-volt output. The +24-volt series element and the +12-volt series element are cascaded; thus, the +24-volt output must be available before the +12-volt regulated circuit can be operational.

Short circuit protection is provided by zener diode CR7 (3.3 volts) and resistors R3 and R6 in the positive regulator and resistor R1 and SCR (silicon-controlled diode) Q5 in the positive power supply. Resistor R1 senses the amount of current being drawn. If the voltage across resistor R1 increases beyond 3.3 volts, zener diode CR7 conducts, applying a potential to the gate of turn-off SCR Q5 by means of voltage divider resistors R3 and R6. Since SCR Q5 is in series with the trip coil of +24V/+12V circuit breaker CB3, current going through the SCR will trip the circuit breaker and remove primary power from the supply.

Overvoltage protection is provided by zener diodes CR9 and CR11 and transistor Q11. Zener diode CR9 (30 volts) senses the +24-volt bus, and zener diode CR11 (18 volts senses the +12-volt bus. If either bus exceeds the associated zener diode voltage, the zener diode conducts and turns on transistor Q11 in the trip circuit of circuit breaker CB3, removing primary power.

4. Negative Power Supply Section

The negative power supply section is functionally identical to the positive supply. The regulated -24-vdc and -12-vdc outputs can be calibrated by -24V VOLT ADJ and -12V VOLT ADJ potentiometers R14 and R10, respectively.

5. Negative Regulator

The negative regulator is essentially the same as the positive regulator. To reverse the polarity of the power supply, the emitter of series transistor Q3 (in the positive output line of the bridge rectifier) is grounded, and transistor Q4 (in the negative return line of the bridge rectifier) is used as a shunt regulator instead of a series regulator. Using transistor Q4 as a shunt regulator also eliminates the need of a second zener diode to sense overvoltage in the -12-volt bus of the regulated output of the supply.

Short circuit protection is provided by zener diode CR7 (3.3 volts) and resistors R3 and R6 in the negative regulator, and resistor R8 and SCR Q6 in the negative power supply. Resistor R8 senses the amount of current being drawn. If the voltage across resistor R8 increases beyond 3.3 volts, zener diode CR7 conducts, applying a potential to the gate of turn-off SCR Q6 by means of voltage divider resistors R3 and R6. Since SCR Q6 is in series with the trip coil of -24V/-12V circuit breaker CB4, current going through the SCR will trip the circuit breaker and remove primary power from the supply.

Overvoltage protection is provided by zener diode CR9 and transistor Q11. Zener diode CR9 (30 volts) senses the -24-volt bus. If the -24-volt bus exceeds 30 volts, zener diode CR9 conducts and turns on transistor Q11 in the trip circuit of circuit breaker CB4, removing primary power.

6. Oven Supply Section

A separate oven supply is incorporated in the power supply to provide 24 volt AC oven heating voltage. The 120-volt AC input power is applied, through MAIN POWER circuit breaker CB1 and fuse F1, to stepdown transformer T3, providing the required 24-volt AC operating voltage for the temperature-controlled crystal ovens of the assemblies in the equipment housing.

7. Monitoring Circuits

STATUS INDICATOR M1, associated multiplier resistors, and front-panel selector switch S2 permit monitoring of the five output voltages of the Power Supply. Potentiometers R17 (24V METER CAL) and R19 (12V METER CAL) are provided to calibrate the metering circuits in the +24/-24-volt and +12/-12-volt supplies. The potentiometers are factory adjusted and should not require readjustment unless STATUS INDICATOR M1 or the associated metering circuits are replaced. To permit monitoring the AC oven voltage on STATUS INDICATOR M1, half-wave rectification is provided by a resistor and diode in the metering circuit. SLO BLO, 2-amp fuse F1, in the input circuit, protects transformer T3 from overloads.

If any circuit breaker or fuse F1 opens (except MAIN POWER circuit breaker CB1) its corresponding amber FAULT INDICATOR lamp goes on. All indicator lamps are equipped with PRESS-TO-TEST lens caps to test the lamps.

IV. MAINTENANCE

A. GENERAL

This section provides the maintenance procedures required to support the Receiver, RF Preselector and the Tunnel Diode Amplifier.

NOTE: Do not make any receiver adjustments before reading paragraphs L and M.

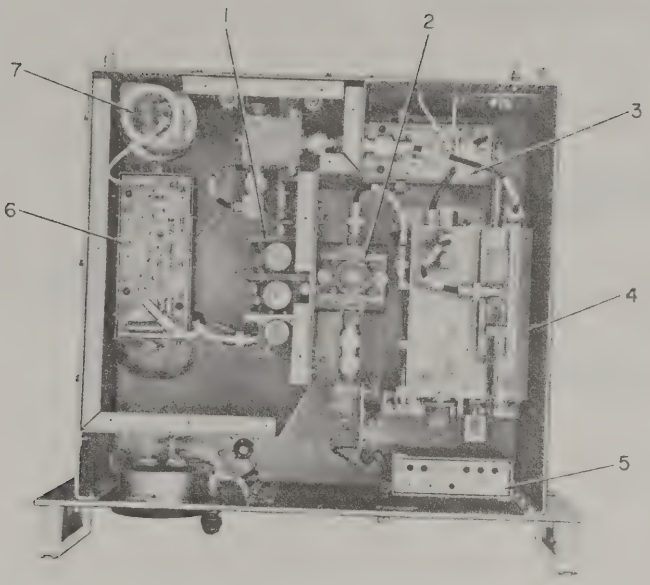
NOTE: For Demodulator test point indications, please refer to Paragraph D-3.

B. MAINTENANCE PROGRAM

1. General

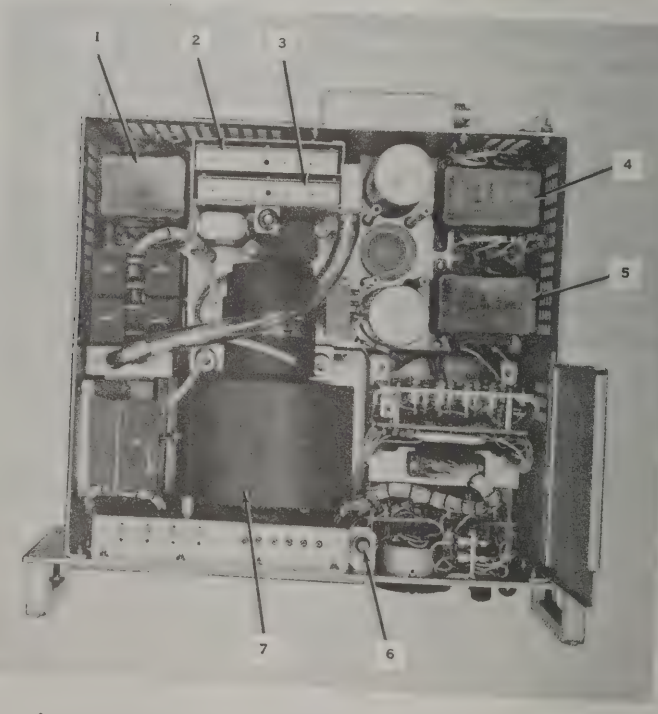
The maintenance program consists of preventive and corrective maintenance. Preventive maintenance commences after the equipment is installed, tested, and operating satisfactorily. Preventive maintenance consists of in-service and out-of-service tests, scheduled on a routine basis as well as additional tests performed on a non-scheduled basis. The purpose of this program is to operate the equipment with a minimum of interruption to service by recognizing deterioration before a malfunction occurs. In-service tests may be scheduled at any convenient time. Out-of-service tests should be coordinated to require a minimum of interruption to service and should be scheduled for periods of light traffic load.

Corrective maintenance consists of trouble localization, minor repairs, replacement of printed circuit cards or modules, and any necessary circuit alignment. Troubles may be localized by use of the indicator lamps, built-in panel meters, test points, and performance and troubleshooting tests. Block and schematic diagrams provide reference information to assist in troubleshooting and isolating of a faulty circuit or circuit element. Figures 4-1 through 4-3 are provided to locate the assemblies within each unit.



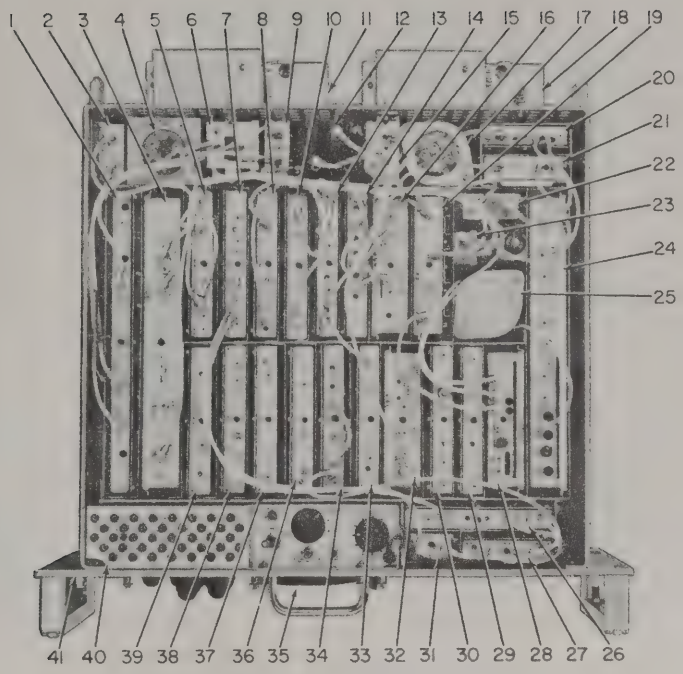
1. SRD Multiplier
2. Preselector
3. I-F Preamplifier
4. Mixer
5. Monitor Control
6. LF Amplifier
7. Oscillator-Doubler

Figure 4-1. Receiver, Frequency Converter



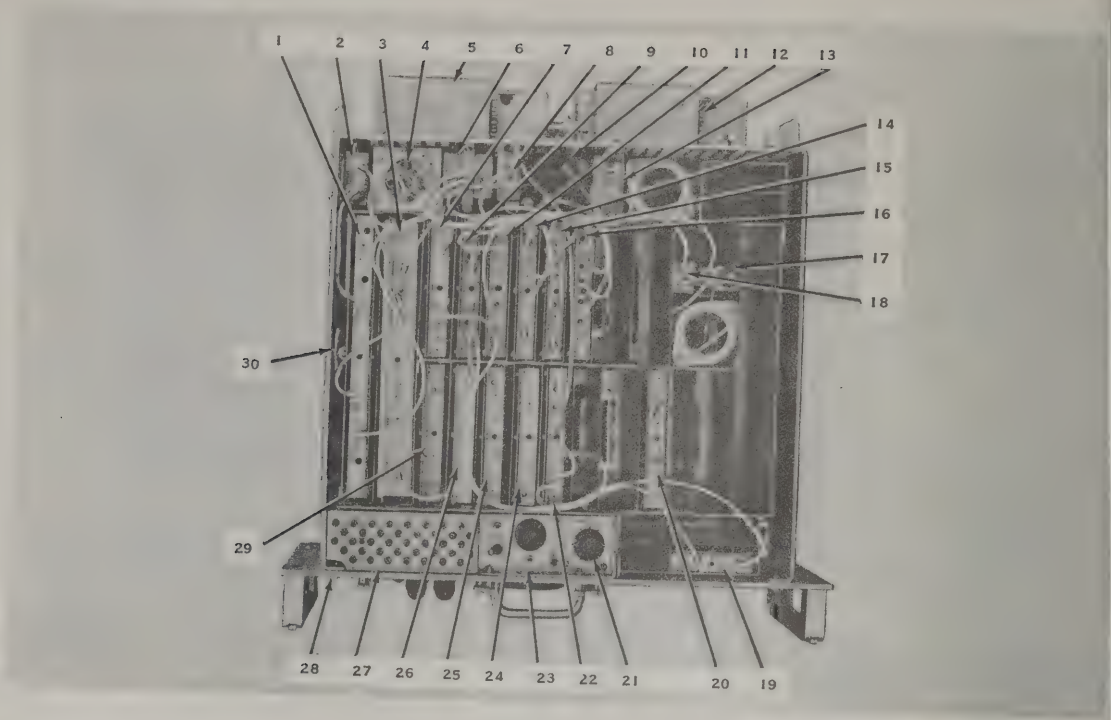
1. Transformer T3
2. -12/-24 Volt Regulator
3. +12/+24 Volt Regulator
4. Transformer T2
5. Transformer T1
6. Fuse F1
7. Blower

Figure 4-2. Receiver, Power Supply-Blower



1. I-F Amplifier (1)
2. I-F Filter
3. Compressor Limiter
4. Driver-Discriminator
5. I-F Amplifier (2)
6. Rumble Filter
7. Distribution Amplifier
8. Pilot Amplifier
9. Low-Pass Filter
10. Noise Amplifier (1)
11. Power Filter Assembly (1)
12. Pilot Crystal Filter
13. Noise Amplifier (2)
14. Noise Amplifier Reflex and Recorder Amplifier
15. High-Pass Filter
16. Compressor-Limiters
17. Reference Oscillator
18. Power Filter Assembly (2)
19. Solid State Switch
20. Mixer
21. Bandwidth Selector
22. Shaping Filter
23. Pilot Filter
24. Limiters Discriminator
25. VCO and Doubler
26. Transfer
27. Channel Capacity Selector
28. Buffer Amplifier
29. Error Amplifier
30. Chopper Demodulator
31. Phase Equalizer
32. Driver Discriminator
33. Wideband Amplifier
34. Combiner
35. Meter and Switch Assembly
36. Baseband Amplifier
37. Order Wire Amplifier
38. Alarm Amplifier
39. Meter Amplifier and Detector
40. Monitor Control Section
41. Front Panel Assembly

Figure 4-3. Demodulator Assemblies (Type 22771)



1. I-F Amplifier (1)
2. I-F Filter
3. Compressor Limiter
4. Driver-Discriminator
5. Power Filter Assembly (1)
6. Rumble Filter
7. I-F Amplifier (2)
8. Low-Pass Filter
9. Distribution Amplifier
10. Pilot Crystal Filter
11. Pilot Amplifier
12. Power Filter Assembly (2)
13. High-Pass Filter
14. Noise Amplifier (1)
15. Noise Amplifier (2)
16. Noise Amplifier Reflex and Recorder Amplifier
17. PC Extractor Tool
18. Pilot Filter
19. Channel Capacity Selector
20. Chopper Demodulator
21. Output Attenuator
22. Combiner
23. Meter and Switch Assembly
24. Baseband Amplifier
25. Order Wire Amplifier
26. Alarm Amplifier
27. Monitor Control Section
28. Front Panel Assembly
29. Meter Amplifier and Detector
30. RF Connector Key

Figure 4-3.1. Demodulator Assemblies (Type 22772)

2. Preventive Maintenance Schedule

The recommended intervals suggested in the Preventive Maintenance Schedule may be adjusted as the needs of the site and experience dictate. In service operating performance tests require no interruption to traffic. They consist primarily of observing indicator lamps and front-panel meters. Out-of-service tests definitely cause an interruption to service and therefore, should be performed during light traffic periods.

PREVENTIVE MAINTENANCE SCHEDULE

Item	Description	Interval	Reference
	IN-SERVICE SCHEDULE		
1	Indicator Lamps	Daily	Sec II, Par. B-1
2	Operating Voltages and Currents	Daily	Sec IV, Par. D-2
	a. Frequency Converter	Daily	Sec IV, Par. D-2a
	b. Demodulator	Daily	Sec IV, Par. D-2b
	c. Power Supply-Blower	Daily	Sec IV, Par. D-2c
	OUT-OF-SERVICE SCHEDULE		
3	Oscillator-Doubler Frequency	Quarterly	Sec IV, Par. D-4
4	Baseband Level and Frequency Response	Quarterly	Sec IV, Par. E-1
5	Order Wire Level and Frequency Response	Quarterly	Sec IV, Par. E-2
6	Radio Pilot Level	Quarterly	Sec IV, Par. E-3
7	Intermodulation Distortion	Quarterly	Sec IV, Par. E-4
8	Quieting Characteristic	Quarterly	Sec IV, Par. E-5
9	D.C. Control Voltage	Quarterly	Sec IV, Par. E-6
10	Transfer Characteristics (Type 1130 only)	Quarterly	Sec IV, Par. E-9

C. RECOMMENDED TEST EQUIPMENT

Optimum performance of the Receiver is realized when adjustments and alignment procedures are made in conjunction with the REL Performance Monitor. However, the Receiver can be adequately serviced using standard test equipment with parameters equivalent to the equipment of the Performance Monitor. The test setups in this section are based upon maximum use of the Performance Monitor.

Input and output levels are provided in voltage and power levels (dbm) in relation to the impedance of the circuit under test. The test equipments supplied with the Performance Monitor have built-in impedance matching networks, multiple jacks and terminating resistances which facilitate test setups and enable levels to be read directly in dbm. In addition, a Modem is supplied which serves as a test standard for the 70-mc portion of the Receiver under test. The instruction manual supporting the Performance Monitor provides detailed information for the operation of this equipment.

In the performance tests and alignment procedures, input levels are measured in relation to the input of the equipment under test. Losses due to test cables and impedance mismatches must be accounted for. Refer to the Table of Recommended Test Equipment for the equipment to be used for the test and alignment procedures in this section. The Table of Recommended Test Equipment is divided into two categories. The first, Routine Test Equipment, lists the test equipment used when making Performance Tests. The second, Special Test Equipment, lists the test equipment used when performing Alignment and Adjustment Procedures. A Test Fixture is recommended to facilitate fault location, testing, and adjusting printed circuit cards and modules. An Adapter Kit, consisting of miscellaneous adapters, cables, cheater assemblies, and air-duct assemblies, is recommended to facilitate the maintenance of printed circuit cards and modules while they are in their equipment drawer.

TABLE OF RECOMMENDED TEST EQUIPMENT

Common Name	Manufacturer and Type
ROUTINE TEST EQUIPMENT OR EQUIVALENT	
AC-VTVM	Ballantine 314
*Attenuator, IF	Radio Engineering Laboratories 22860
DC VTVM	RCA WV 98C
Frequency Counter	Hewlett-Packard 5245L with frequency converters 5245B and 5253B
*Loop Converter	Radio Engineering Laboratories 1061A
*Modem - Jackfield	Radio Engineering Laboratories 22871-22841
*Part of REL Performance Monitor	

TABLE OF RECOMMENDED TEST EQUIPMENT (Cont)

Common Name	Manufacturer and Type
ROUTINE TEST EQUIPMENT OR EQUIVALENT (Cont)	
Multimeter	Simpson 260
*Noise Analyzer	Radio Engineering Laboratories 22821
*Noise Generator	Radio Engineering Laboratories 22831
*Oscillator	Radio Engineering Laboratories 22800
Oscilloscope	Hewlett-Packard 130C
RF Voltmeter	Boonton 91CA
*Up-Converter	Radio Engineering Laboratories 23942
VHF Signal Generator	Hewlett-Packard 608D
SPECIAL TEST EQUIPMENT OR EQUIVALENT	
Adaptor Kit	Radio Engineering Laboratories 24180
AGC Bias Box	(Refer to figure 4-25)
Attenuator, RF 10 db	Microlab AB-10N
Attenuator, RF 20 db	Microlab AB-20N with 2 Micon Adaptors
Capacitor	100 microfarad, 50 watts dcv
Delay and Linearity Test Receiver	RCA CS81 (with RCA Demodulator)
Delay and Linearity Test Transmitter	RCA CS80
Detector (Crystal)	Alfred 1001
Frequency Meter	Hewlett-Packard 536A
*Part of REL Performance Monitor	

TABLE OF RECOMMENDED TEST EQUIPMENT (Cont)

Common Name	Manufacturer and Type
SPECIAL TEST EQUIPMENT OR EQUIVALENT (Cont)	
High-Impedance Detector Probe	Heathkit 337W-c
IF Amplifier	Hewlett-Packard 461A
Microwave Power Meter	Hewlett-Packard 431B with 478A Thermistor Mount
Oscilloscope	Hewlett-Packard 140A with Time Base 1420A and Dual Trace Amplifier 1401A
Resistor	3900 ohm
Slotted Line	Hewlett-Packard 805C
Termination, 50 ohms	Microlab TA-5-MN
UHF Signal Generators	Hewlett-Packard 614B and 616B
UHF Sweep Generator	Hewlett-Packard H03-683C
VHF Sweep Generator	Jerrold 900A
VSWR Detector	Telonic RHO-Tector TRB-1
VSWR Indicator	Hewlett-Packard 415B
*VTVM	Radio Engineering Laboratories 22812
Test Fixture	Radio Engineering Laboratories 25280
*Part of REL Performance Monitor	

D. TROUBLESHOOTING

Troubleshooting tests are performed to localize malfunctions in the Receiver. Localization starts with a front panel indication, generally an amber lamp going on. This indicates a specific malfunction has occurred. The built-in metering facilities are then used to localize the trouble to a specific section and the test points are used to isolate the trouble to a specific module.

1. Equipment Fault Indications

A malfunction in the Receiver may cause a fault indication, or it may cause a gradual deterioration in reception, without triggering an alarm. The Fault Indications and Troubleshooting Chart lists the various front panel fault indications that may occur and provides a procedure for localizing the malfunction. A gradual deterioration in reception can be avoided by adhering to the preventive maintenance program outlined in paragraph B-2. All indicator lamps are equipped with press-to-test caps to rule out the lamp as the source of a malfunction. When the lamp cap is pressed, the lamp should go on or the bulb should be replaced.

The troubleshooting instructions in the Fault Indications and Troubleshooting Chart are dependent upon; the Receiver being either in-service or operating in a test loop. It is also assumed that troubleshooting on a site-to-site system basis, or on an Exciter-Receiver looping basis has been performed, and that the malfunction has been localized to the Receiver.

FAULT INDICATIONS AND TROUBLESHOOTING CHART

Step	Indication	Analysis	Corrective Action
		TUNNEL DIODE AMPLIFIER	
1	HTR INDICATOR DS1 goes off	No AC power being applied to TDA	a. Check that the AC power plug is connected to AC receptacle J3. b. Check for blown heater fuse (1 amp Slo-Blo). c. Check for faulty HTR ON-OFF Switch S1.
2	HTR FUSE indicator DS2 goes on	Fuse blown	Check for short in AC input circuit.

FAULT INDICATIONS AND TROUBLESHOOTING CHART (Cont)

Step	Indication	Analysis	Corrective Action
		FREQUENCY CONVERTER	
1	OVEN HEATER DS1 not cycling	Oscillator-Doubler Oven not being maintained at a constant temperature	Check Oven voltage: a. If voltage is not present, check 24 VAC circuit in Power Supply-Blower. b. If voltage is present, replace Oscillator-Doubler Oven. Refer to paragraph K-3 for replacement of oven.
		DEMODULATOR	
1	RAD PLT FIL OVEN HEATER INDICATOR DS6 not cycling	Oven is not being maintained at a constant temperature	Check Oven voltage: a. If voltage is not present, check 24 VAC circuit in Power Supply-Blower. b. If voltage is present, replace the Pilot Crystal Filter Module.
2	DISCR OVEN HEATER INDICATOR DS9 not cycling	Oven is not being maintained at a constant temperature	Check Oven voltage: a. If voltage is not present, check 24 VAC circuit in Power Supply-Blower. b. If voltage is present, replace Driver Discriminator Oven.
3	BASEBAND FAULT lamp DS10 on	No baseband signal	Check RAD PLT FAULT lamp DS12: a. If lamp DS12 is off, check position 8 of the Demodulator metering switch (paragraph D-2b). If the correct indication is obtained, replace the Alarm Amplifier. b. If lamp DS12 is on, see step 4.
4	RAD PLT FAULT lamp DS12 is on	No radio pilot signal	If the Exciter is transmitting a radio pilot signal, check the IF Amplifier and Wideband Demodulator circuits (paragraph D-3).

FAULT INDICATIONS AND TROUBLESHOOTING CHART (Cont)

Step	Indication	Analysis	Corrective Action
		DEMODULATOR (Cont)	
*5	NOISE AMPL PLT FAULT lamp DS11 is on	No radio pilot signal	Check RAD PLT FAULT lamp DS12: a. If lamp DS12 is off, check Noise Amplifier 2 output in the Table of Demodulator Test Points (paragraph D-3). If the correct indication is obtained, replace the Noise Amplifier Reflex and Recorder Amplifier. If the indication is not correct, check Noise Amplifier (1) and (2). b. If lamp DS12 is on, see step 4.
		POWER SUPPLY-BLOWER	
1	MAIN POWER ON lamp DS1 goes off	MAIN POWER ON lamp DS1 goes off when MAIN POWER circuit breaker CB1 trips	A short in 120-volt AC output has occurred. Check the load between pin connections JJ and LL of connector J3. A fault has occurred in subsequent circuit breakers CB2 through CB4.
2	BLOWER FAULT INDICATOR lamp DS2 goes on	BLOWER FAULT INDICATOR lamp DS2 goes on when BLOWER circuit breaker CB2 trips	Check for defective Blower Motor.
3	+24V/+12V FAULT INDICATOR lamp DS3 goes on	Goes on when BLOWER circuit breaker CB2 is ON and +24V/+12V circuit breaker CB3 trips	Check for a short in the +24V/+12V external load. If not load, check rectifiers or Transformer T1.

*The pilot reflex is made inoperative under certain strong signal conditions. Please refer to Appendix A, paragraph 2.

FAULT INDICATIONS AND TROUBLESHOOTING CHART (Cont)

Step	Indication	Analysis	Corrective Action
		POWER SUPPLY-BLOWER (Cont)	
4	-24V/-12V FAULT INDICATOR lamp DS4 goes on	Goes on when BLOWER circuit breaker CB2 is ON and -24V/-12V circuit breaker CB2 trips	Check for a short in the -24V/-12V external load. If not load, check rectifiers or Transformer T2.
5	OVENS FAULT INDICATOR lamp DS5 goes on	Goes on when fuse F1 opens	Check for a short in the external Heater Circuits, or short in Transformer T3.

2. Receiver Operating Voltages and Currents*

These checks are made on the Receiver, with the front-panel meters and associated function selector switches, in order to localize a malfunction to a specifi section. The normal limits of the voltages and currents are indicated by color band and in some instances, numerical values, on the meter scales. Some of these check may be performed either while the equipment is in service or operating in a test loo with proper test tones. If a requirement is not met, the corrective action is given. This may consist of replacing a printed circuit card or module, or providing a reference to a particular section in the Table of Demodulator Test Points (paragraph D-3).

a. Frequency Converter

The FUNCTION SELECTOR switch positions listed in the Frequency Converter Metering and Troubleshooting Chart can be checked as required, or in accordance with the preventive maintenance schedule recommended in paragraph B-2 Before making the checks listed in the chart, observe the fault indicators on the fron panel of the Demodulator. If one or more of the fault indicator lamps are on, refer to the Fault Indications and Troubleshooting Chart (paragraph D-1) and follow the procedure that corresponds to the particular condition.

*Refer to paragraph L.

FREQUENCY CONVERTER METERING AND TROUBLESHOOTING CHART

Switch Function	Switch Position	Meter Limit	Corrective Action When Meter Limit Indication is Exceeded
Test Points	12*	Red	Refer to Injection Chain Alignment Procedure (paragraph G-1c.
24 VAC Oven voltage	11	Blue	Check 24 VAC circuit in Power Supply-Blower
Spare	10	None	Not Applicable
Spare	9	None	Not Applicable
Oscillator-Doubler Output	8	Red	Refer to the Injection Chain Alignment Procedure (paragraph G-1a).
Low Frequency Amplifier	7	Red	Refer to the Injection Chain Alignment Procedure (paragraph G-1b).
SRD Multiplier	6	Red	Refer to the Injection Chain Alignment Procedure (paragraph G-1c).
-12 volts	5	Green	Check -12/-24 Volt Regulator Circuit in Power Supply-Blower (paragraph D-2c).
+12 volts	4	Green	Check +12/+24 Volt Regulator Circuit in Power Supply-Blower (paragraph D-2c).
-24 volts	3	Green	Check -12/-24 Volt Regulator Circuit in Power Supply-Blower (paragraph D-2c).
+24 volts	2	Green	Check +12/+24 Volt Regulator Circuit in Power Supply-Blower (paragraph D-2c).
Mixer Crystal Current	1	Blue	Perform the RF Gain and Bandwidth Test (paragraph E-8).

*Connect test probe (red) to test point TP2 on Monitor Control Module

b. Demodulator

The FUNCTION SELECTOR switch positions listed in the Demodulator Metering and Troubleshooting Chart should be checked as required, or in accordanc with the preventive maintenance schedule recommended in paragraph B-2. When a malfunction occurs, the front-panel Fault Indicators should be analyzed in accordan with the Fault Indications and Troubleshooting Chart (paragraph D-1) before any test-point measurements are made. Only those switch positions used are included in the table.

DEMODULATOR METERING AND TROUBLESHOOTING CHART*

Switch Function	Switch Position	Meter Limit	Corrective Action When Meter Limit Indication is Exceeded
Baseband Combiner Current	1	2 to 5* 0 to 10**	Check DC Control Voltage at TP10 on Combiner Card and check other voltage on Combiner Card. Check Combiner Defeat Switch connections and Meter cabling connections.
Order Wire Combiner Current	2	2 to 10**	Check DC Control Voltage at TP10 on Combiner Card and check other voltage on Combiner Card. Check Combiner Defeat Switch connections and Meter cabling connections.
+24 volts	3	Green	Check the +12/+24 Volt Regulator Circuit in the Power Supply-Blower (paragraph D-2).
-24 volts	4	Green	Check the -12/-24 Volt Regulator Circuit in the Power Supply-Blower (paragraph D-2).
+12 volts	5	Green	Check the +12/+24 Volt Regulator Circuit in the Power Supply-Blower (paragraph D-2).
-12 volts	6	Green	Check the -12/-24 Volt Regulator Circuit in the Power Supply-Blower (paragraph D-2).

Measurements made with input signal of -60 dbm into TDA.
*Requirement for a single Receiver
**Requirement for a Receiver operating in diversity mode

* Refer to paragraph L.

DEMODULATOR METERING AND TROUBLESHOOTING CHART (Cont)

Switch Function	Switch Position	Meter Limit	Corrective Action When Meter Limit Indication is Exceeded
Spare	7	None	Not Applicable
Baseband Amplifier	8	Green***	Check position 1 for correct indication. If correct indication is obtained, check the Baseband Amplifier.
Error Amplifier output (1130 only)	9	zero to 1.5	Check the AFC components of the Threshold Extension Section (paragraph D-3).
Error Amplifier output (1130 only)	10	zero	Same as switch position 9.
DC Test Points	11	None	See paragraph D-3.
AC Test Points	12	None	See paragraph D-3.

Measurements made with input signal of -60 dbm into TDA.
***With 12-kc Test Tone applied to the mating Exciter.

c. Power Supply-Blower

Observe the FAULT INDICATORS on the front panel of the Power Supply-Blower. If one or more of the indicator lamps are on, refer to the Fault Indications and Analysis Chart (paragraph D-1) and follow the procedure that corresponds to the observed fault indication.

POWER SUPPLY-BLOWER METERING AND TROUBLESHOOTING CHART

Switch Function	Switch Position	Meter Limit	Corrective Action When Meter Limit Indication is Exceeded
24 VAC Unregulated Oven Supply	1	Red	Check Transformer T3. Check Meter Selector Switch S2.
+24 Volt Regulated	2	Green	Check +12/+24 Volt Regulator. Check common components of Positive Regulator. Adjust METER CAL potentiometer R17.* Check Selector Switch S2.

*Use a well calibrated Standard Voltmeter as reference.

POWER SUPPLY-BLOWER METERING AND TROUBLESHOOTING CHART (Cont)

Switch Function	Switch Position	Meter Limit	Corrective Action When Meter Limit Indication is Exceeded
-24 Volt Regulated Supply	3	Green	Check -12/-24 Volt Regulator. Check common components of Negative Regulator. Adjust METER CAL potentiometer R17. Check Selector Switch S2.
+12 Volt Regulated	4	Green	Check +12/+24 Volt Regulator. Check common components of Positive Regulator. Adjust METER CAL potentiometer R19. Check Selector Switch S2.
-12 Volt Regulated Supply	5	Green	Check -12/-24 Volt Regulator. Check common components of Positive Regulator. Adjust METER CAL potentiometer R19. Check Selector Switch S2.

*Use a well calibrated Standard Voltmeter as reference.

3. Demodulator Test-Point Indications

The Table of Demodulator Test-Point Indications is the final step in trouble-shooting the Receiver. The Demodulator is divided into various functional circuits to permit rapid location of the required test points. Each circuit is monitored by the front-panel meter in conjunction with the test points and built-in test probes.

The test points are grouped in the table according to functional circuits and the use of mid-points will permit quick isolation of the faulty circuit. If the correct indication is not obtained, replace the printed circuit card or module indicated by the test point function. Those test points that cannot be tested while the Receiver is in service are identified by an asterisk. However, for the most reliable results, it is recommended that all of these checks be made with the Receiver out of service.

TABLE OF DEMODULATOR TEST-POINT INDICATIONS

Test-Point Function	Switch Position	Red Probe	Black Probe	Meter Limit
IF AMPLIFIER CIRCUITS				
IF Amplifier I AGC Voltage	Position 11	TP1	TP37	3 min
IF Amplifier I Output	Position 11	TP2	TP3	3 to 9
IF Ampl II Output to Comp-Lim	Position 11	TP4	TP5	3 to 9
IF Ampl II Output to TE Mixer	Position 11	TP6	TP7	3 to 9
WIDEBAND DEMODULATOR				
Compressor Limiter Output	Position 11	TP8	TP37	3 to 9
Driver Discriminator Output	Position 12	TP9	TP37	3 to 9**
Distribution Amplifier Output	Position 12	TP10	TP37	5 to 9**
BASEBAND CIRCUITS				
Transfer Output	Position 12	TP11	TP37	5 to 9**
Channel Capacity Selector Output	Position 12	TP35	TP37	5 to 9**
ORDER WIRE CIRCUITS				
Transfer Order Wire Output (1130)	Position 12	TP12	TP37	3 to 9***
Order Wire Amplifier Output	Position 12	TP13	TP37	Red***
NOISE AND PILOT AMPLIFIER CIRCUITS				
Noise Amplifier II Output	Position 11	TP15	TP37	3 to 9*
Noise Amplifier Reflex Output DC control voltage	Position 11	TP16	TP37	3 to 9*
Pilot Amplifier Output	Position 11	TP17	TP37	5 to 9****
OVEN VOLTAGE SUPPLY CIRCUITS				
24 VAC Oven	Position 12	TP36	TP37	5 to 9

These indications are valid for an RF input of -60 dbm at the input to the Tunnel Diode Amplifier unless otherwise indicated.

*Measurement taken with same RF input signal level required to set the DC Control Voltage (figure 4-11A, 4-11B or 4-11C).

**Based on 12-kc Test Tone; in normal operation, indication varies with traffic.

***Based on 1-kc Test Tone; in normal operation, indication varies with traffic.

****Pilot Tone must be present when making this check.

4. Check of Oscillator-Doubler Operating Frequency

The purpose of this check is to determine that the Oscillator-Doubler in the Frequency Converter is operating at the proper frequency. This is an out-of-servi check, requiring the RF Input Cable to be disconnected when the Frequency Conver Drawer is pulled all the way out.

a. Connect a Frequency Counter to RF MON jack J1 on the Oscillator-Doubler. The indication should correspond to the frequency marked on the crystal ±200 cps.

NOTE: The Oscillator-Doubler frequency may be off by as much as ±10 cps without any degradation in Receiver performance.

b. If the requirement as marked on the crystal oven is not met within ±1000 cps, adjust capacitor C5 on the Oscillator-Doubler until the requirement is met.

c. If the requirement still can not be met, replace the crystal and/or oven as instructed in paragraph K-3 and check the frequency as in step a. Use the tuning procedure as in paragraph G-1a.

E. PERFORMANCE TESTS

Performance Tests are carried out on the Receiver according to the in-service and out-of-service preventive maintenance schedules, paragraph B2. Additional tests not listed in the preventive maintenance schedules may be performed on a non-scheduled basis to localize trouble and to test out equipment or circuits suspected of being in trouble. Performance tests for the RF Preselector and Tunnel Diode Amplifier are also included.

Some procedures are most easily performed on a system basis, with an Exciter or Modem that has been checked and operating properly. The most accessible and convenient test points should be chosen for injecting and measuring test tones and signals. The test setups in these procedures recognize the functional points for connections, not necessarily the most convenient points. The arrangement and availability of central patching and monitoring facilities at the equipment site dictate the most convenient points to connect test equipment for system tests.

NOTE: It is essential that the Modem and the Converters of the Performance Monitor have been previously tested on a back-to-back basis and are operating satisfactorily; thereby, not contributing any error in the Receiver measurements.

1. Baseband Level and Frequency Response Test

The purpose of this test is to determine the condition of the overall Receiver by measuring the baseband level and response at the output of the Receiver. The entire Receiver is employed in this test and if the requirements are not met, the trouble may be localized by repeating the test for the Demodulator only. A Loop or Up-Converter, a Modem, Oscillator, VTVM, and 10-db Attenuator are required for this procedure.

NOTE: If a Modem is not available, an REL Exciter that has been thoroughly checked and is operating properly can be substituted. Refer to the Exciter Instruction Manual for circuit connections.

a. On the Modem:

(1) Set the CHAN CAP SELECTOR switch S5 to the position representing the channel capacity of the system under test.

(2) Deactivate the Radio Pilot circuit on the Modem's Test Exciter by connecting shorting cap P40 at RADIO PILOT DEFEAT jack J32.

b. On the Receiver, set COMBINER DEFEAT switch S1, RADIO PILOT DEFEAT switch S2, NOISE AMPL PILOT DEFEAT switch S3 and THRESHOLD EXTENSION DEFEAT switch S4 to DEFEAT.

c. Connect the equipment as shown in figure 4-4, option 1 or 2.

NOTE: Use option 1 whenever possible.

d. Set the Oscillator for 60 kc and the baseband input level for -45 dbm.

e. Make sure the BB OUTPUT ATTENUATOR (23560) on the Receiver is s to NORM.

f. Measure -15 dbm, within ±0.5 db on the VTVM.

g. If the requirements in step f cannot be met, connect the equipment as shown in figure 4-4, option 3, and repeat step f for the Demodulator onl

h. If the requirement of step g cannot be met, disconnect the Oscillator fro the Modem and observe that the baseband output level decreases by a minimum of 20 db. If this requirement is not met, localize and correct the excessive noise in the Receiver.

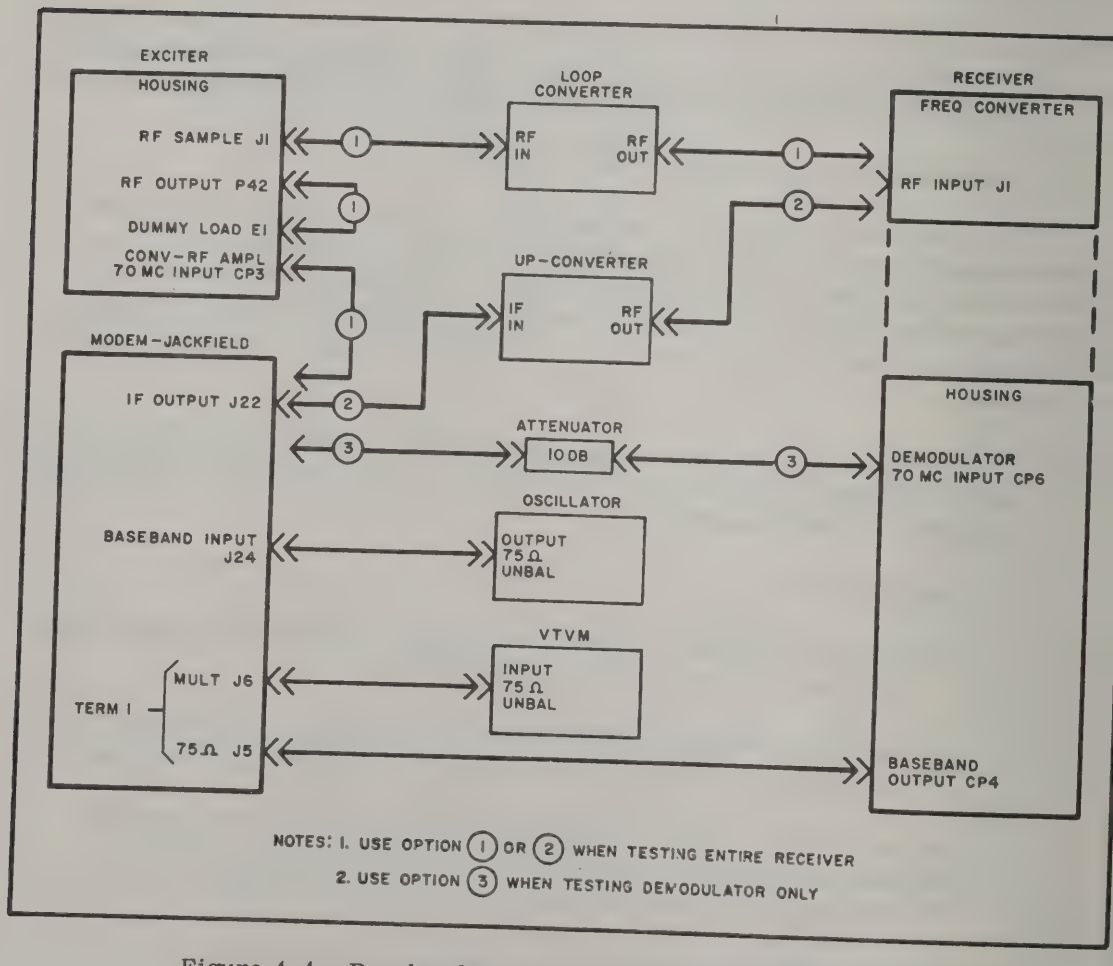


Figure 4-4. Baseband Level and Frequency Response Test

i. If the requirement of step f still cannot be met, perform the Baseband Level Adjustment procedure (paragraph F-1).

j. If the requirement in step f is met, check the response for the following baseband frequencies according to the channel capacity of the equipment under test (72 Channels: 12, 60, 150 and 300 kc) (120/132 Channels: 12, 60, 150, 300, 450 and 552 kc). (240/252 channels 12, 60, 150, 300, 450, 552, and 1052 kc.)

k. The requirement is ±0.25 db response for every 250 kc of bandwidth.

l. If the requirements are not met, connect the equipment as shown in figure 4-4, option 3, and repeat step j for the Demodulator only.

m. If the requirement of step k is not met, perform the Baseband Frequency Response Test and Adjustment procedure (paragraph F-1).

n. If the requirement of step k is met with the Demodulator test setup, while not met with the RF test setup, check the RF Bandwidth of the Frequency Converter (paragraph E-8).

o. If the requirement of step k is not met with the Demodulator test setup, check the IF Bandwidth of the Demodulator (paragraph E-7).

p. Set THRESHOLD DEFEAT switch S4 to TEST and repeat steps d through j. If the requirement is not met, check the alignment of the Threshold Extension Circuit (paragraph F-8). (Type 1130 Receiver only).

q. When all requirements have been met, remove all test equipment. Restore all cables and switches for normal operation.

2. Order Wire Level and Frequency Response Test

The purpose of this test is to determine the condition of the overall Receiver by measuring the order wire level and frequency response at the output of the Receiver. The entire Receiver is employed in this test and if the requirements are not met, the trouble may be localized by repeating the test for the Demodulator only. A Loop or Up-Converter, Modem, Oscillator, VTVM, and 10-db Attenuator are required for this test.

NOTE: If a Modem is not available, an REL Exciter that has been thoroughly checked and is operating properly can be substituted. Refer to the Exciter Instruction Manual for circuit connections.

a. On the Modem:

(1) Deactivate the Radio Pilot circuit on the Modem's Test Exciter by connecting shorting cap P40 to RADIO PILOT DEFEAT jack J32.

(2) Set CHAN CAP SELECTOR switch S5 to the position representing channel capacity of the system under test.

b. On the Receiver, set COMBINER DEFEAT switch S1, RADIO PILOT DEFEAT switch S2, NOISE AMPL PILOT DEFEAT switch S3 and THRESHOLD EXT DEFEAT switch S4 to DEFEAT.

c. Connect the equipment as shown in figure 4-5, option 1 or 2.

d. Set the Oscillator frequency for 1 kc and the order wire output level to -30 dbm.

e. Check that the order wire level indicated on the VTVM is -15 dbm withi ±0.5 db. Use this as the reference level for future tests.

f. If the requirement is not met, connect the equipment as shown in figure 4-5, option 3, and repeat step e for the Demodulator only.

(1) If the requirement is met with the Demodulator test setup, while no met in the RF test setup, check that the order wire output level decreases by a minimum of 20 db when the 1-kc signal input level to the Modem is removed. If this requirement is not met, correct the excessive noise in the Receiver.

(2) If the requirement is not met with the Demodulator test setup, perfo the Order Wire Level Test and Adjustment procedure (paragraph F-

g. If the requirement of step e is met, check the frequency response at the following order wire frequencies: 0.25, 0.5, 1, 4, 12 kc. The response for any frequency within the order wire range should be within -2 to +1 d of the reference level at 1 kc.

h. Set THRESHOLD EXT DEFEAT switch S4 to TEST and repeat steps d through g. If the requirement can be met, check the alignment of the Threshold Extension Circuit (paragraph F-8). (Type 1130 Receiver only

i. When all requirements are met, remove all test equipment. Restore all cables and switches for normal operation.

3. Radio Pilot Level Test

The purpose of this test is to determine the Radio Pilot Circuit in the Demodulator is operating properly. A VTVM, a Modem, and a 10-db Attenuator are required for this procedure.

NOTE: If a Modem is not available, an REL Exciter that has been thoroughly checked and is operating properly can be substituted. Refer to the Exciter Instruction Manual for circuit connections.

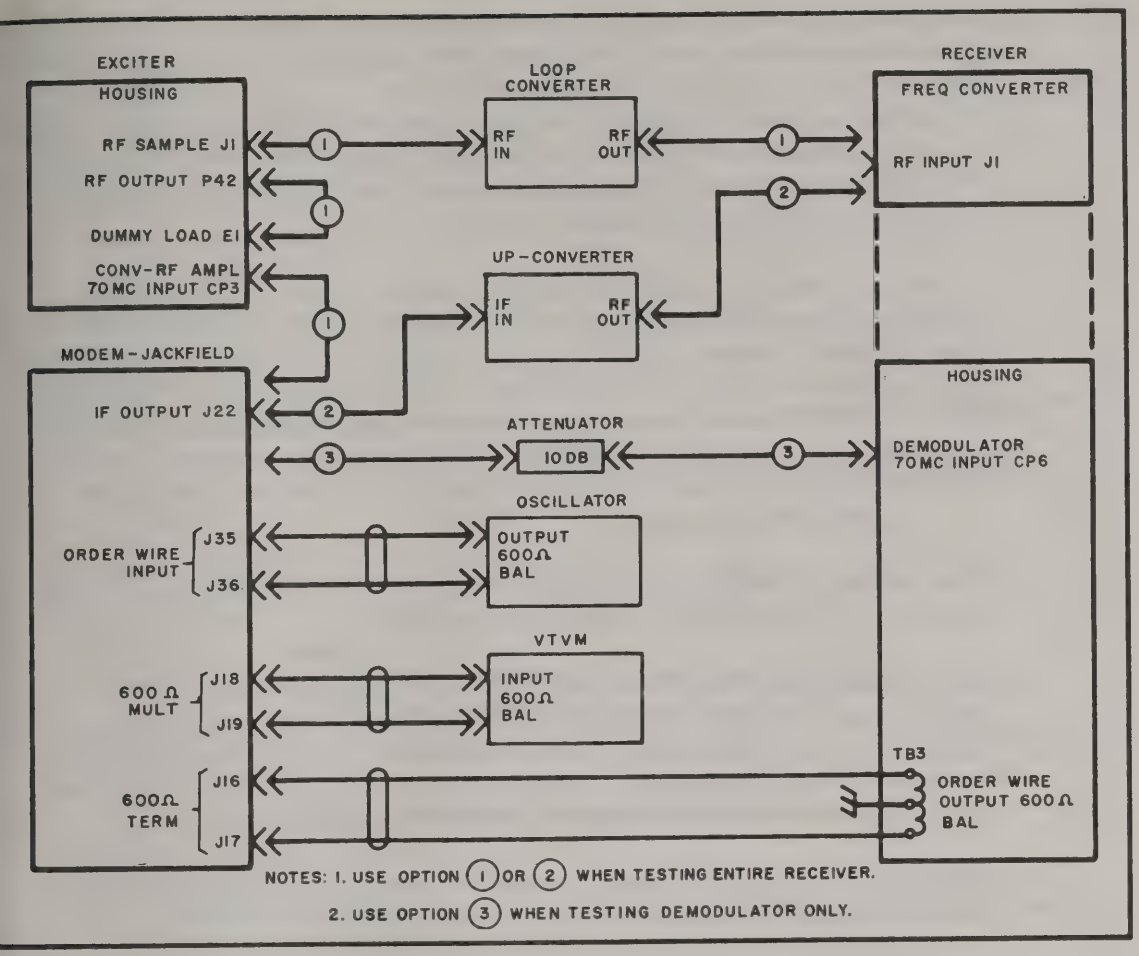


Figure 4-5. Order Wire Level and Frequency Response Test

a. Connect the test equipment (except for the Oscillator) as shown in figure 4-4 (option 3).

b. On the Modem:

(1) Set the CHAN CAP SELECTOR switch S5 to the position representing the channel capacity of the equipment under test.

(2) Activate the Radio Pilot circuit on the Modem's Test Exciter by removing shorting cap P40 from RADIO PILOT DEFEAT jack 32.

c. On the Demodulator, set NOISE AMPL PILOT DEFEAT switch S3 and RADIO PILOT DEFEAT switch S2 to NORM.

d. The pilot level should be 10 db below the baseband level or -24 dbm ±0.5. Observe that NOISE AMPL PLT lamp DS11 and RAD PLT lamp DS12 are. (On the 1130A the level should be -25 dbn).

e. If the requirement of step d is not met, connect a Ballantine 314 AC VTV to test point TP5 and ground on the Channel Capacity Selector Card. The VTVM should indicate 5 to 6 millivolts with Radio Pilot present and the Baseband and Order Wire Signals removed.

f. If the requirement is still not met, remove all cables and remove the Pilot Amplifier Card from the drawer. Insert Extension Card in the Demodulator Drawer. Insert Pilot Amplifier Card in the Extension Card and connect the cables to the Pilot Amplifier Card. Connect a Ballantine 314 AC VTVM to test point TP11. If pilot signal is present, Radio Pilot level is measured at test point TP11. This should be between 1.4 to 1.7 volts ac when the Front-Panel Meter indicates "7" as per Radio Pilot Level Adjustment procedure.

g. On the Modem, deactivate the Radio Pilot Circuit by connecting shorting cap P40 to RADIO PILOT DEFEAT jack J32.

h. On the Receiver, check that RAD PLT lamp DS12, BASEBAND lamp DS10 go on. If NOISE AMPL PLT lamp DS11 does not go on, remove plug P24 from connector J1 on Noise Amplifier (1). NOISE AMPL PLT lamp DS11 should now go on. If the requirements are not met, perform the Radio Pilot Level and Reflex Alignment test (paragraph F-7).

i. When all requirements have been met, remove all test equipment. Restore all cables and switches for normal operation.

4. Intermodulation Distortion Test

The purpose of this test is to determine that the intermodulation distortion and residual noise in the Receiver is within acceptable limits and will not interfere with the proper operation of the Receiver. A Loop or Up-Converter, Modem, Noise Generator, Noise Analyzer, and 10-db Attenuator are required for this procedure.

NOTE: If a Modem is not available, an REL Exciter that has been thoroughly checked and is operating properly can be substituted. Refer to the Exciter Instruction Manual for circuit connections.

a. On the Modem, set the CHAN CAP SELECTOR switch S5 to the position representing the channel capacity of the equipment under test.

b. On the Receiver, set COMBINER DEFEAT switch S1 and THRESHOLD EXT DEFEAT switch S4 to DEFEAT.

c. Connect the equipment as shown in figure 4-6, option 1 or 2. Use option 1 whenever possible.

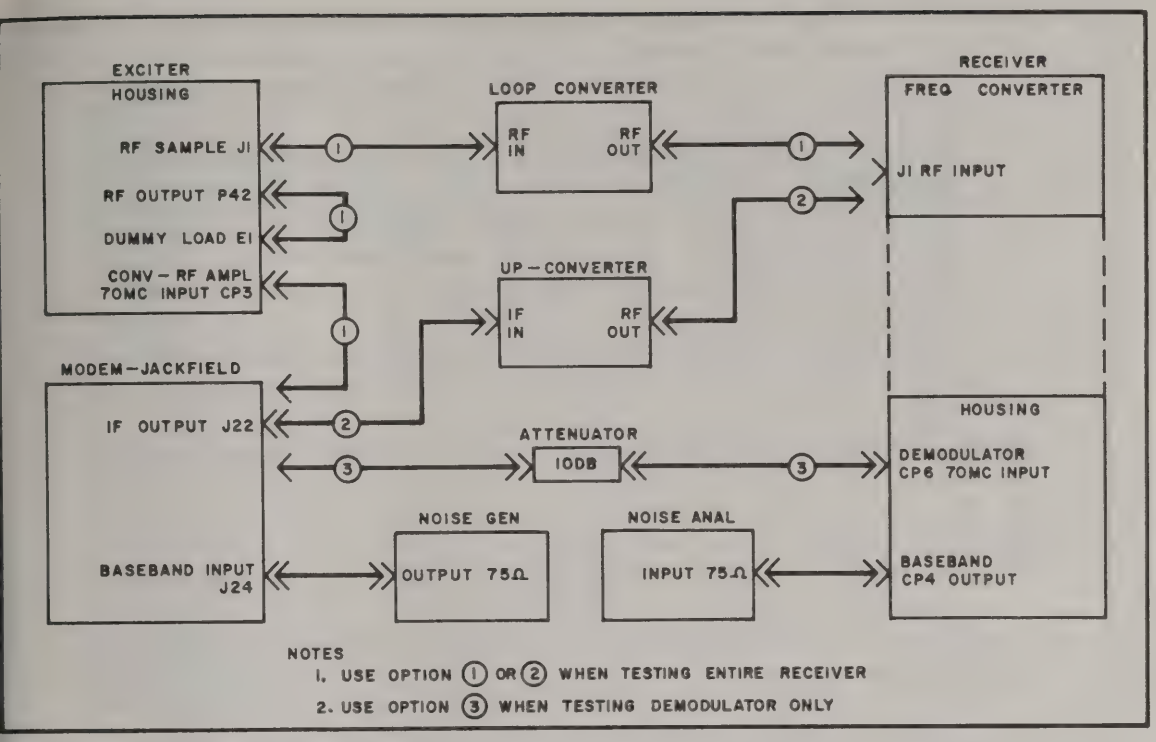


Figure 4-6. Intermodulation Distortion Test

d. Calibrate the Noise Generator for a noise spectrum equivalent to the baseband frequency range: 72 channels 12 to 300 kc, 120/132 channels 12 to 552 kc and 240/252 channels 12 to 1052 kc.

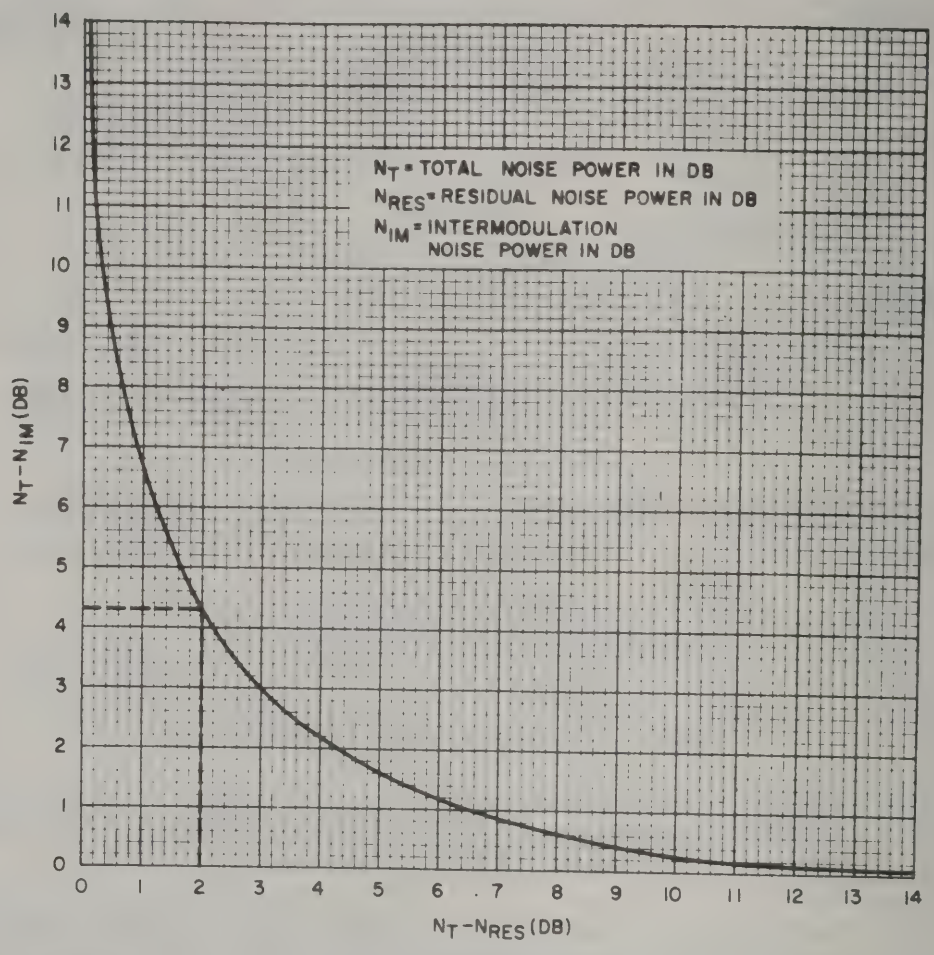
e. Set the noise level on the Noise Generator Meter according to the channel capacity of the equipment under test: 72 channels -38.6 dbm, 132 channels -37.5 dbm and 252 channels -36 dbm.

f. Calibrate the Noise Analyzer for the 80 kc frequency slot.

g. Insert the Band-Eliminate Filter in the Noise Generator and check that the input noise level in step e remains constant.

h. Adjust the Attenuators on the Noise Analyzer, measure and record the total noise (N_T).

i. Disconnect the Noise Generator from J24 and measure the residual noise (N_{RES}).



EXAMPLE

(1) If total noise power . . . (N_T) = -56 db;

(2) And if residual noise power (BINR). . . . . (N_{RES}) = -58 db;

(3) Then the value read on the horizontal axis (abscissa) of the graph is difference . . . . . (N_T-N_{RES}) or 2 db;

(4) Locate this value of (N_T-N_{RES}) on the curve.

(5) Read the corresponding value on the vertical axis (ordinate) of the graph for . . . . . (N_T-N_{IM}) or 4.3 db;

(6) Solve the resulting equation by substitution. . . . . N_T-N_{IM} = 4.3 db;

or -56 db-N_{IM} = 4.3 db;

or -56 db-4.3 db = N_{IM};

or -60.3 db = N_{IM}

(7) Thus, the intermodulation noise power N_{IM} (or actual IM) is . . . . . -60.3 db.

Figure 4-7. Noise Power Curve

j. Using the values of N_T and N_{RES}, compute the value of the intermodulation distortion as shown in the Noise Power Curve (figure 4-7). The requirement is -55 db or better.

k. Repeat steps d through j for the remaining frequency slots according to the channel capacity of the equipment under test (72 Channels: 15, 256 kc) (132 Channels: 15, 265, 475 kc). (252 channels 15, 265, 905 kc).

l. If the requirements of steps j and k are not met:

(1) Connect the equipment as shown in figure 4-6, option 3, and repeat steps d through k.

(2) If these requirements are met, trouble exists in the Frequency Converter.

(3) If the requirements are still not met, perform the Group Delay and Linearity Adjustment (paragraph F-3).

m. Set THRESHOLD EXT DEFEAT switch S4 to TEST and repeat steps d through k. The Threshold-Extension requirement is -35 db or better. (Not used on Type 1130A Receiver).

n. When all requirements have been met, remove all test equipment and restore all cables and switches for normal operation.

5. Quieting Characteristic Test

The purpose of this test is to check the quieting characteristic or sensitivity of the Receiver. A Loop or Up-Converter, Noise Analyzer, Modem, UHF Signal Generator, and a 20-db Attenuator are required for this procedure.

NOTE: If a Modem is not available, an REL Exciter that has been thoroughly checked and is operating properly can be substituted. Refer to the Exciter Instruction Manual for circuit connections.

a. On the Modem, set the CHAN CAP SELECTOR switch S5 to the position representing the channel capacity of the equipment under test.

b. On the Demodulator, set COMBINER DEFEAT switch S1, RADIO PILOT DEFEAT switch S2, NOISE AMPL PILOT DEFEAT switch S3 and THRESHOLD EXT DEFEAT switch S4 to DEFEAT. (S4 not used on Type 1130A).

c. Connect the equipment for calibration as shown in A, figure 4-8.

d. Set the attenuators on the Noise Analyzer for 90 db of attenuation.

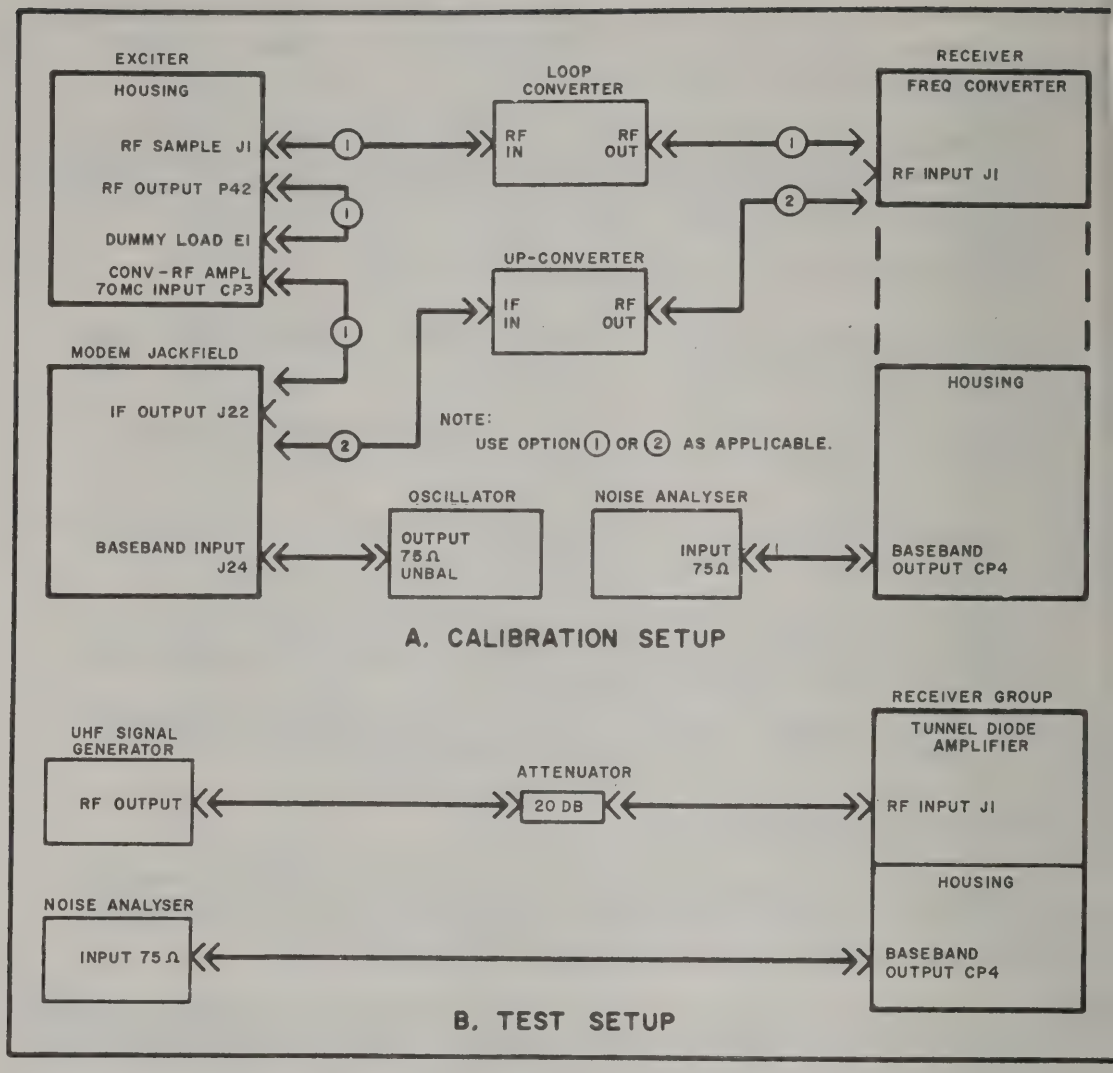


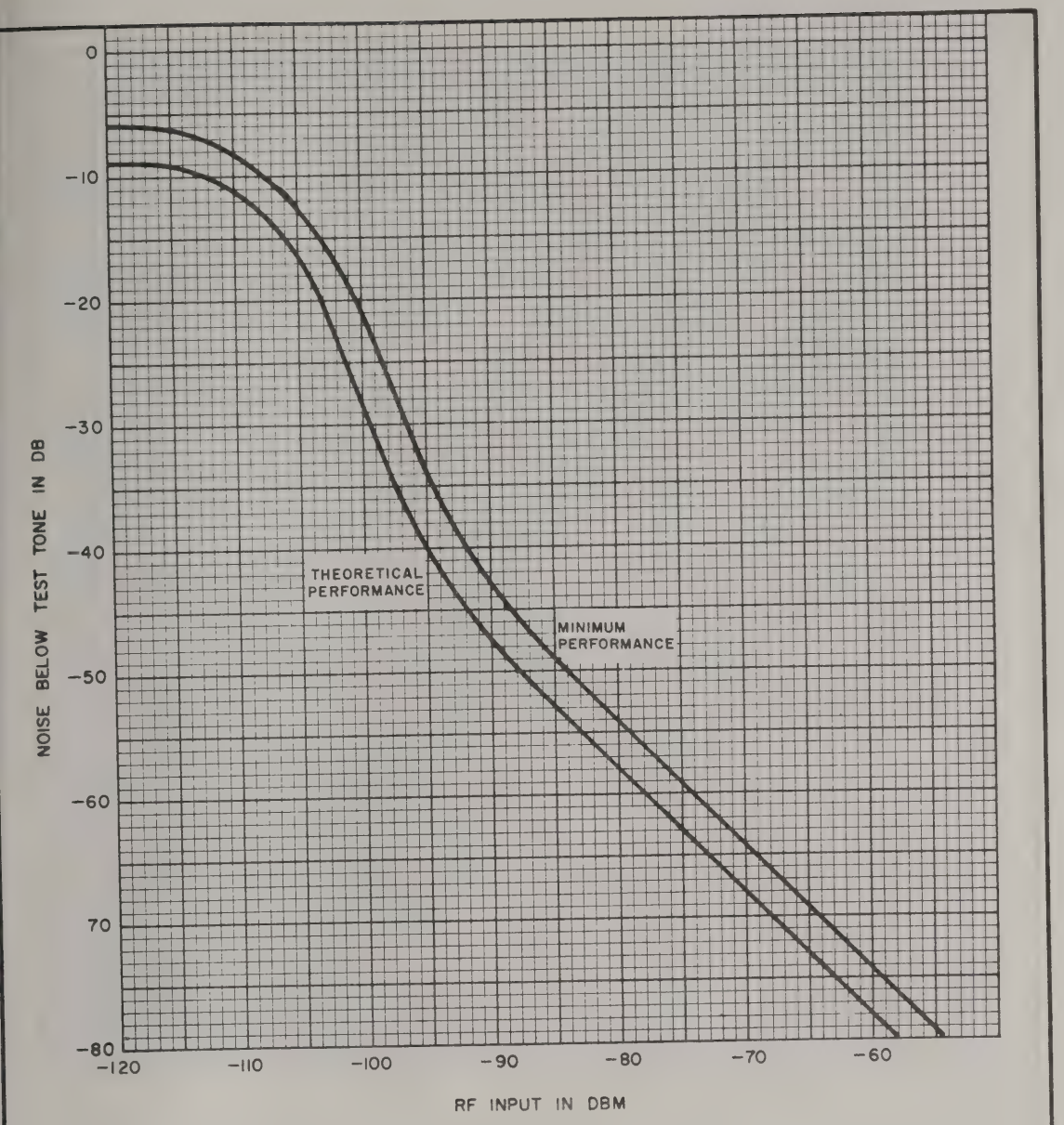
Figure 4-8. Receiver Quieting Test

e. Set the frequency of the Oscillator to 80 kc at a baseband input level of -45 dbm.

f. Peak the Oscillator frequency for maximum indication on the Noise Analyzer. If two peaks are observed, use the highest peak.

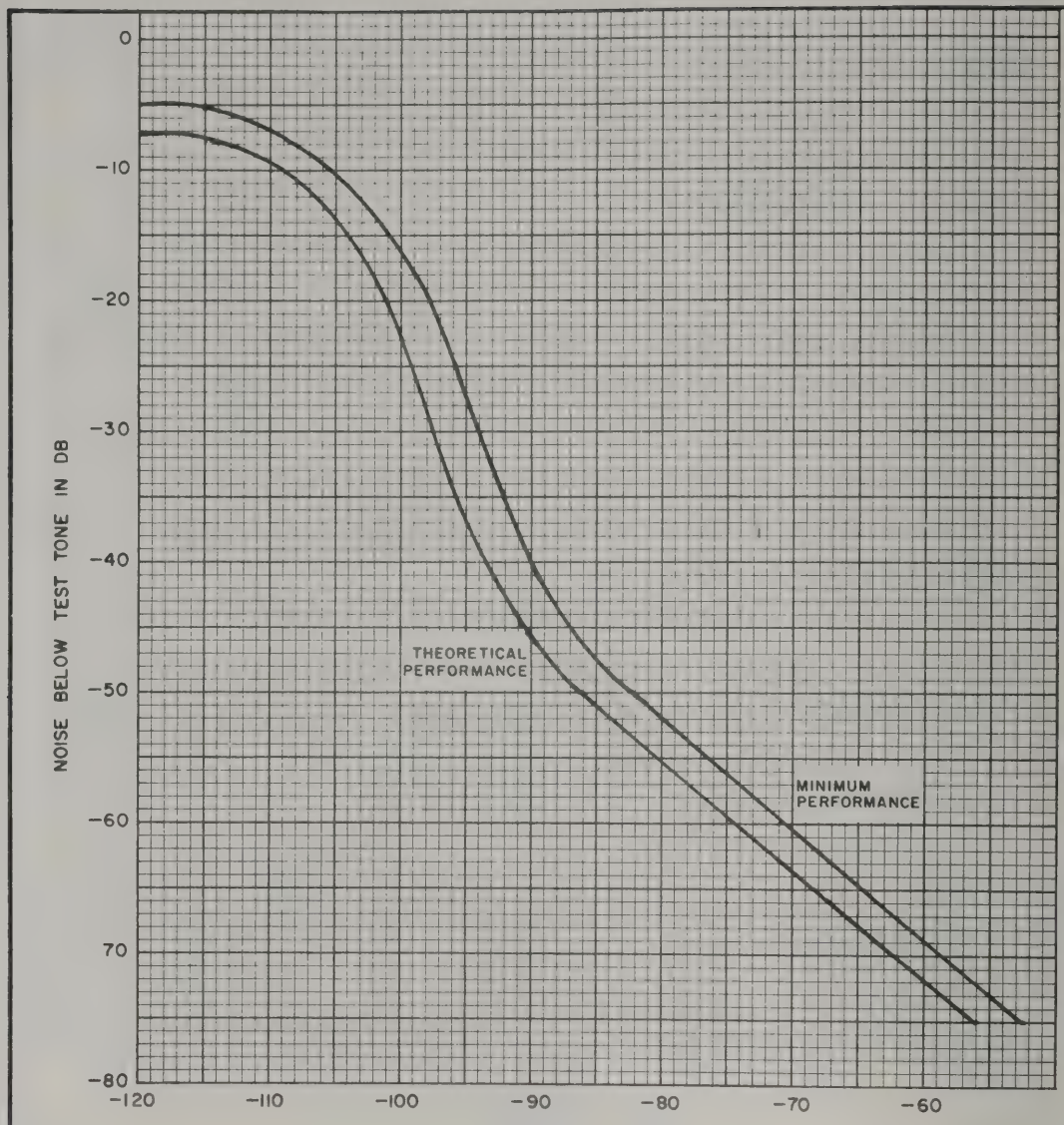
g. Calibrate the Noise Analyzer for zero reference point (midscale) on the meter.

h. Connect the equipment as shown in part B, figure 4-8. Do not touch the controls on the Noise Analyzer.



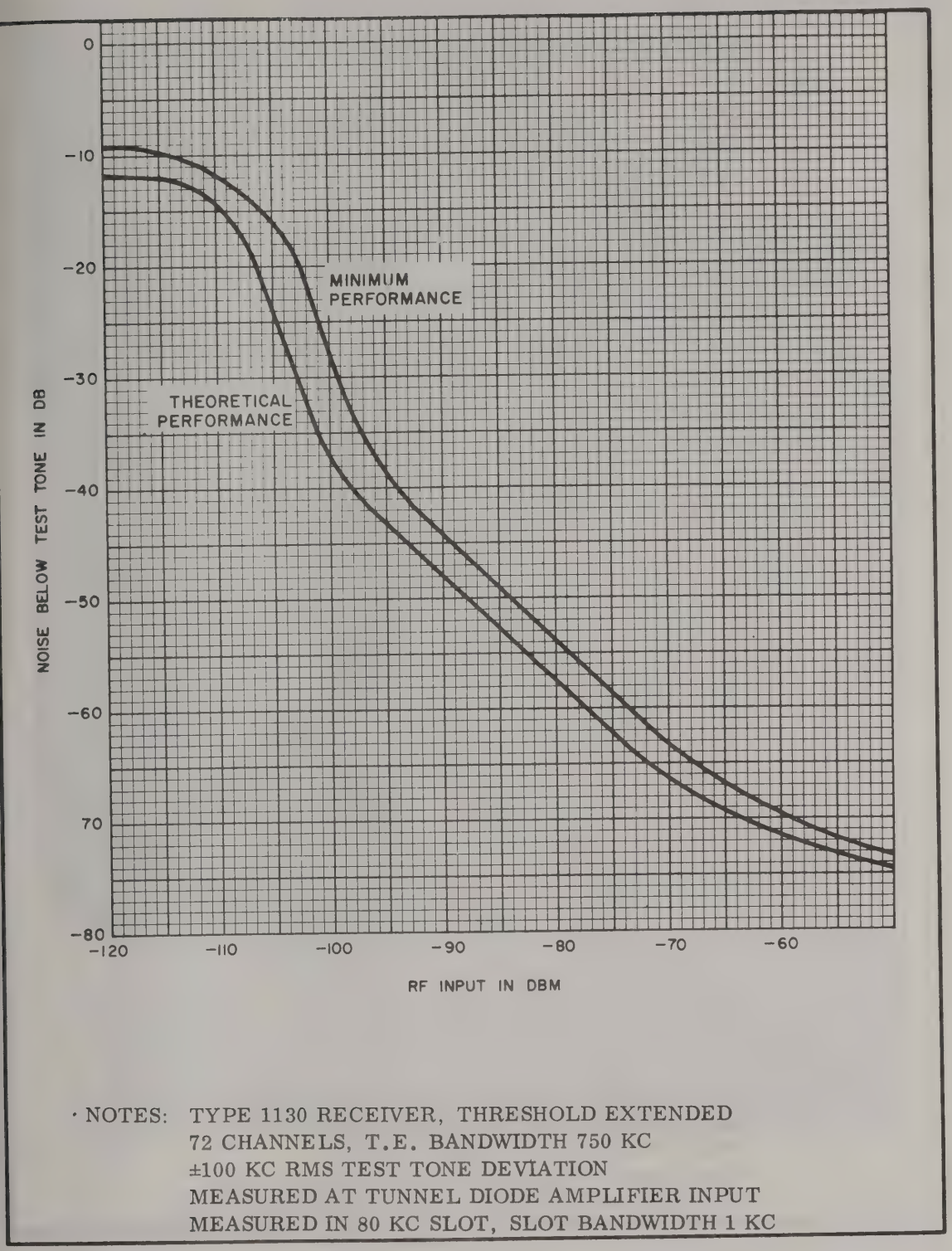
NOTES: TYPE 1130 RECEIVER, THRESHOLD NORMAL
72 CHANNELS, 3 MC BANDWIDTH
±100 KC RMS TEST TONE DEVIATION
MEASURED AT TUNNEL DIODE AMPLIFIER INPUT
MEASURED IN 80 KC SLOT, SLOT BANDWIDTH 1 KC

Figure 4-9A. 72-Channel Quieting Characteristics Curve Threshold Normal



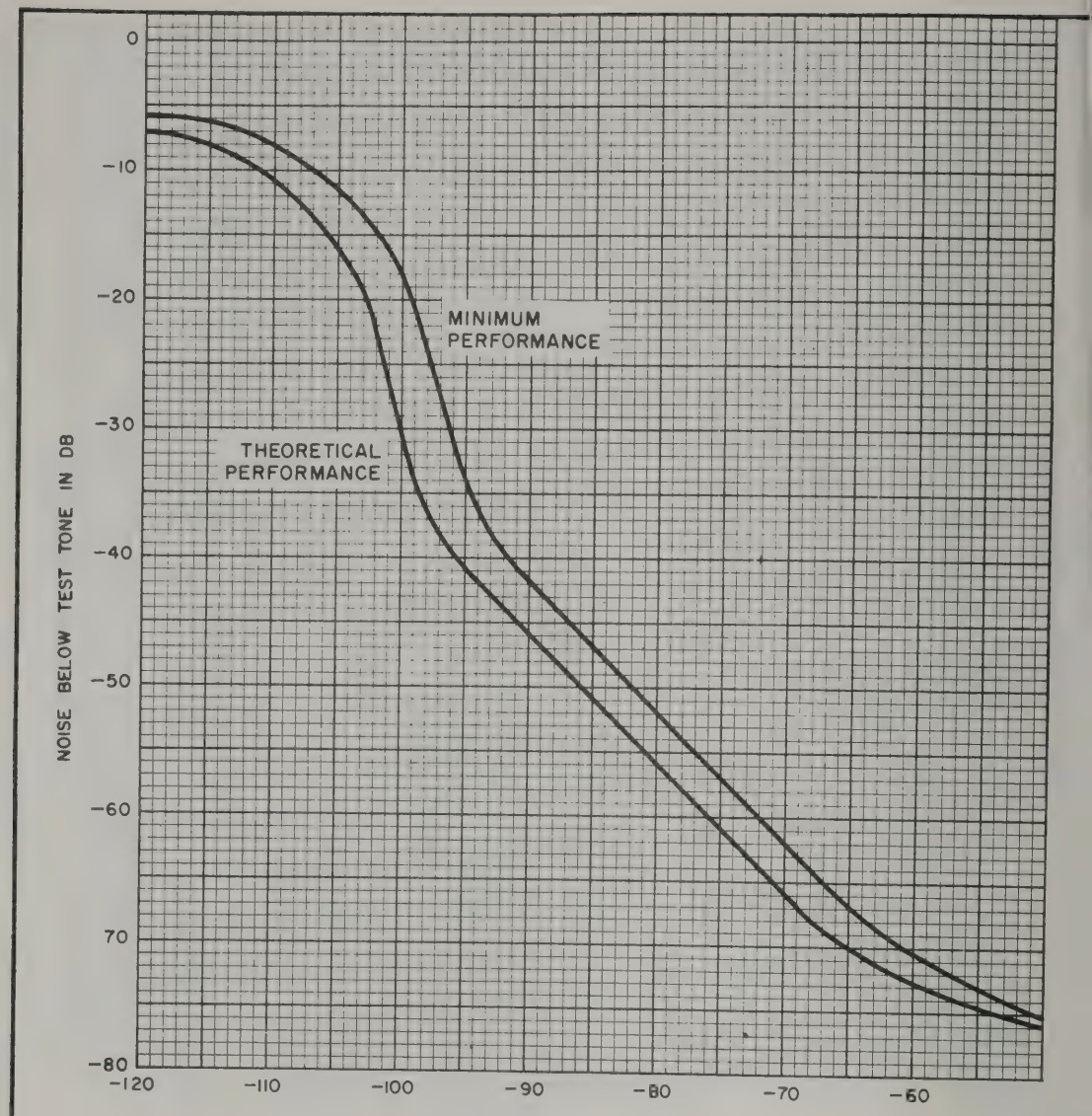
NOTES: TYPE 1130 RECEIVER, THRESHOLD NORMAL
132 CHANNELS, 6 MC BANDWIDTH
±100 KC RMS TEST TONE DEVIATION
MEASURED AT TUNNEL DIODE AMPLIFIER INPUT
MEASURED IN 80 KC SLOT, SLOT BANDWIDTH 1 KC

Figure 4-9B. 132-Channel Quieting Characteristic Curve Threshold Normal



· NOTES: TYPE 1130 RECEIVER, THRESHOLD EXTENDED
72 CHANNELS, T.E. BANDWIDTH 750 KC
±100 KC RMS TEST TONE DEVIATION
MEASURED AT TUNNEL DIODE AMPLIFIER INPUT
MEASURED IN 80 KC SLOT, SLOT BANDWIDTH 1 KC

Figure 4-9C. 72-Channel Quieting Characteristic Curve Threshold Extended



NOTES: TYPE 1130 RECEIVER, THRESHOLD EXTENDED
132 CHANNELS, T.E. BANDWIDTH 1.0 MC
±100 KC RMS TEST TONE DEVIATION
MEASURED AT TUNNEL DIODE AMPLIFIER INPUT
MEASURED IN 80 KC SLOT, SLOT BANDWIDTH 1 KC

Figure 4-9D. 132-Channel Quieting Characteristic Curve Threshold Extended

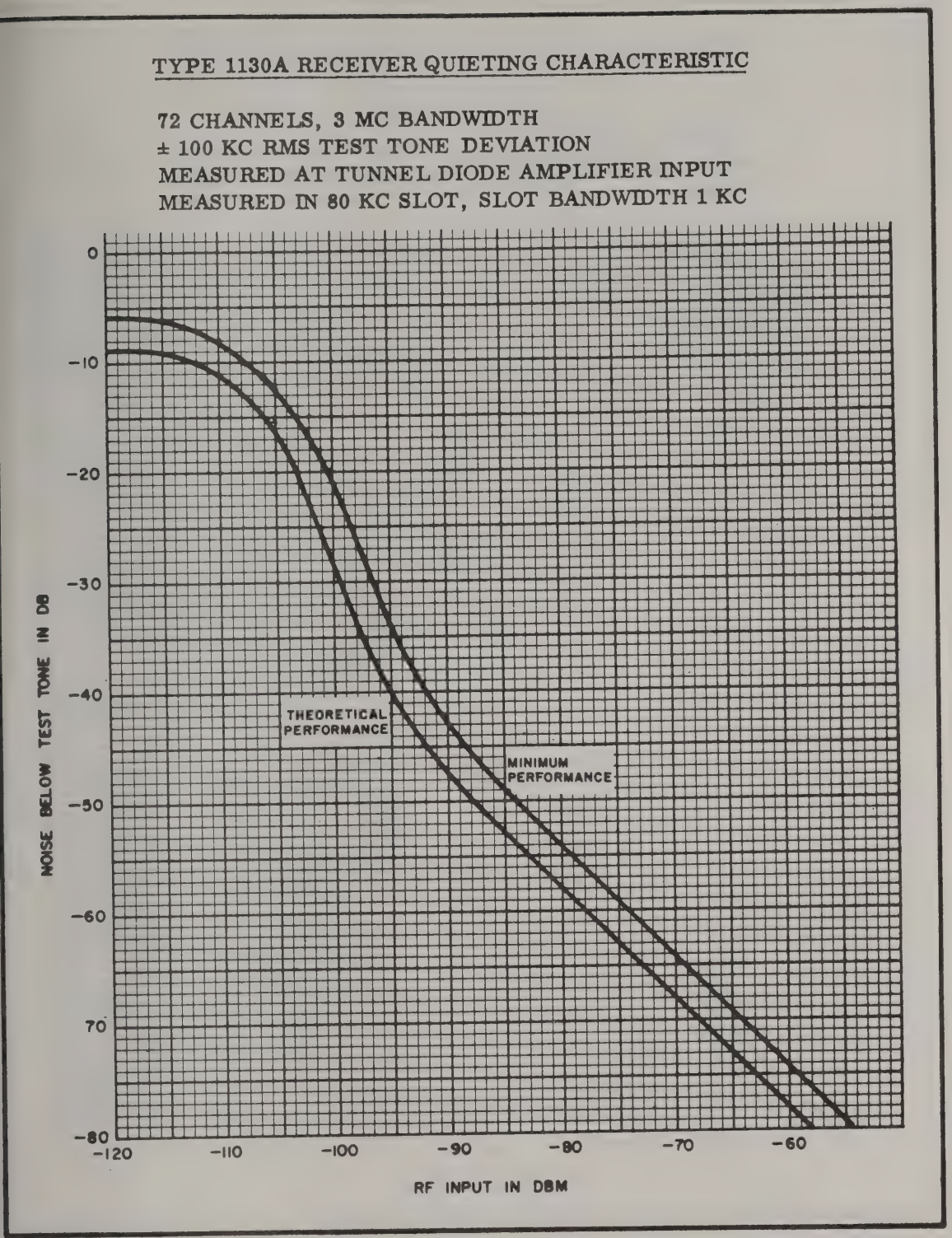


Figure 4-9A.1. 72-Channel Receiver Quieting Characteristic Curve

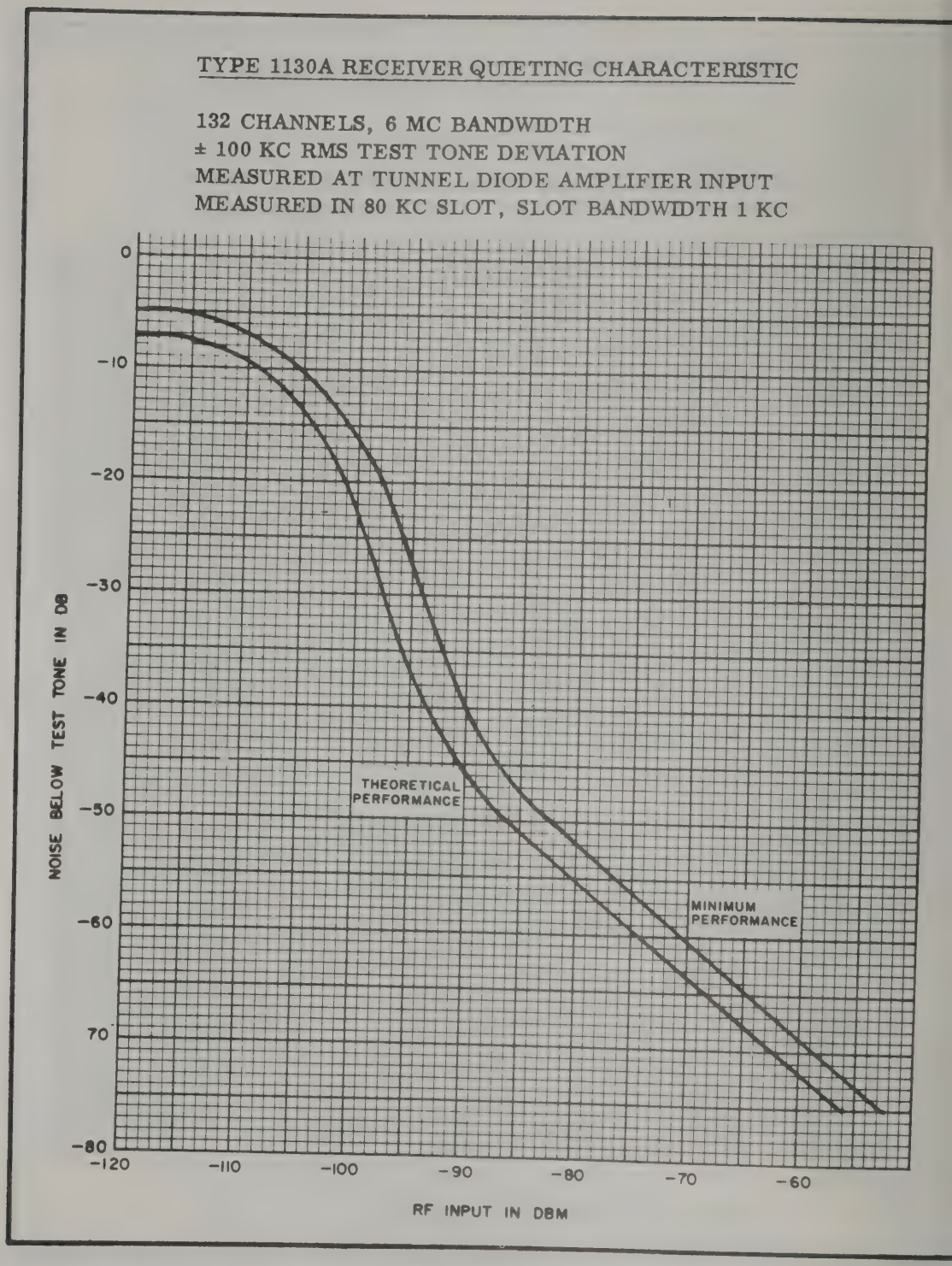


Figure 4-9B.1. 132-Channel Receiver Quieting Characteristic Curve

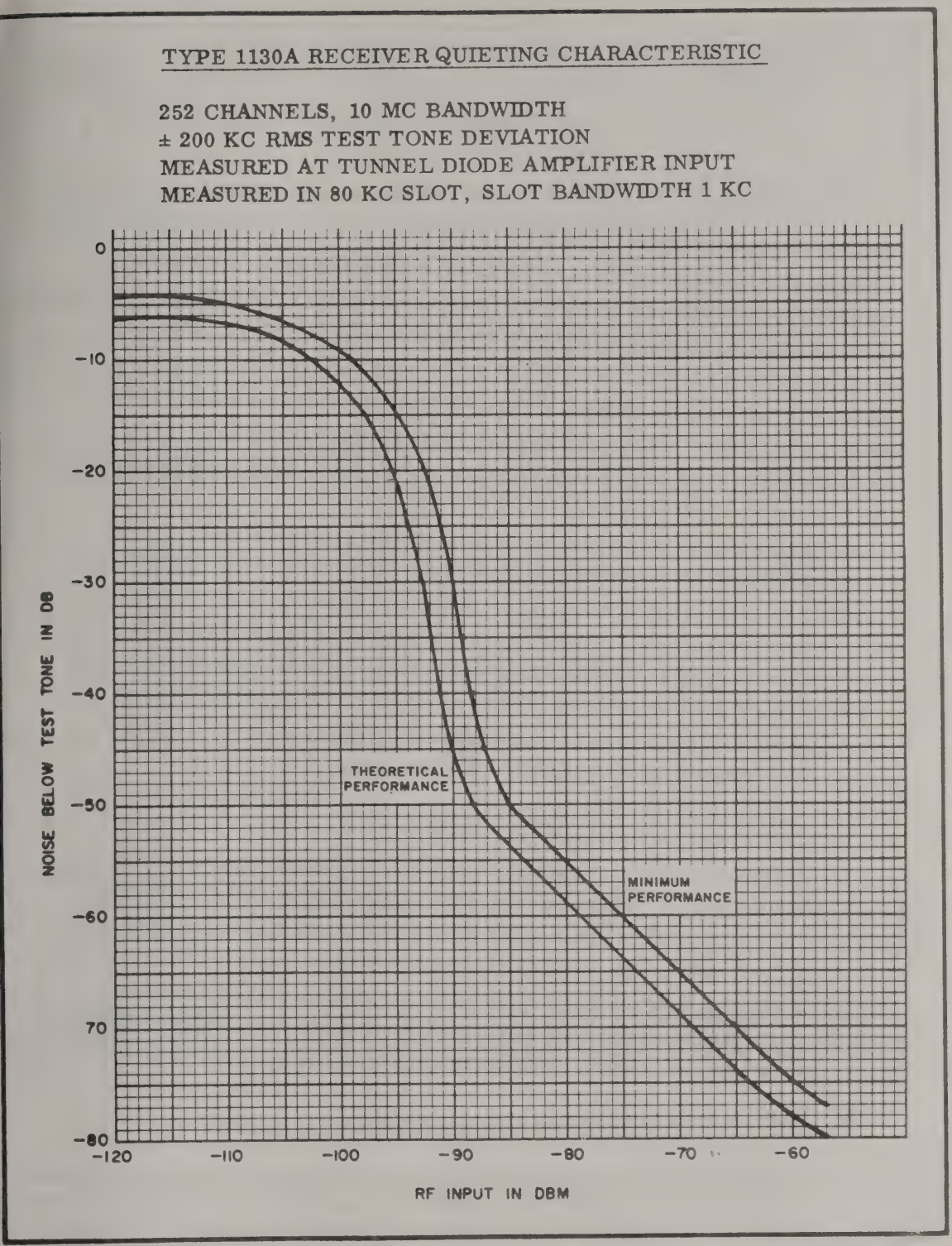


Figure 4-9C.1. 252-Channel Receiver Quieting Characteristic Curve

i. Set the UHF Signal Generator with a 20-db Attenuator at the output, for the assigned RF input frequency of the Receiver. (Use the Discriminator on the Demodulator to read discriminator crossover.) Set the Signal Generator for a level of -30 dbm.

j. Allowing for the input equipment losses (cables and 20-db Attenuator), set the output of the UHF Signal Generator for an input level of -120 dbm to the Receiver.

k. Readjust the Attenuators on the Noise Analyzer for the midscale reference point and record the change in db.

l. Repeat step k for RF input levels of -110, -105, -103, -100, -98, -95, -9 -80, -70 and -60 dbm.

m. Check that the data recorded falls between the limits established on the quieting curve (figure 4-9A or 4-9B).

n. If the requirement is not met, check the RF gain, noise figure, or Demodulator performance (paragraph F).

o. Set THRESHOLD EXT DEFEAT switch S4 to TEST and repeat steps c through m. If the requirement (figure 4-9C or 4-9D is not met, align the Threshold Extension Circuit (paragraph F-8). (Type 1130 only)

p. When all requirements have been met, remove all test equipment. Restor all cables and switches for normal operation.

6. DC Control Voltage Characteristic Test

The purpose of this test is to determine that the DC control voltage characteristics meet the slope requirements and that the voltages required for transfer and combiner control are operating at the proper point. A UHF Signal Generator, DC VTVM, and a 20-db Attenuator are required for this test.

a. Set COMBINER DEFEAT switch S1, RADIO PILOT DEFEAT switch S2, and NOISE AMPL PILOT DEFEAT switch S3, to DEFEAT. Set THRESHOL EXT DEFEAT switch S4 to NORMAL, (type 1130 only).

b. Connect the equipment as shown in figure 4-10.

c. Set the UHF Signal Generator with a 20-db Attenuator at the output, to the assigned RF frequency of the Receiver at an input level to the equipment (make up for cable and 20-db Attenuator losses) according to the channel capacity of the Receiver under test; 72 Channels -91 dbm and 132 Channels -88 dbm, and 252 Channels -85 dbm.

d. Measure -5.0 volts dc within ±0.1 volt at test point TP6.

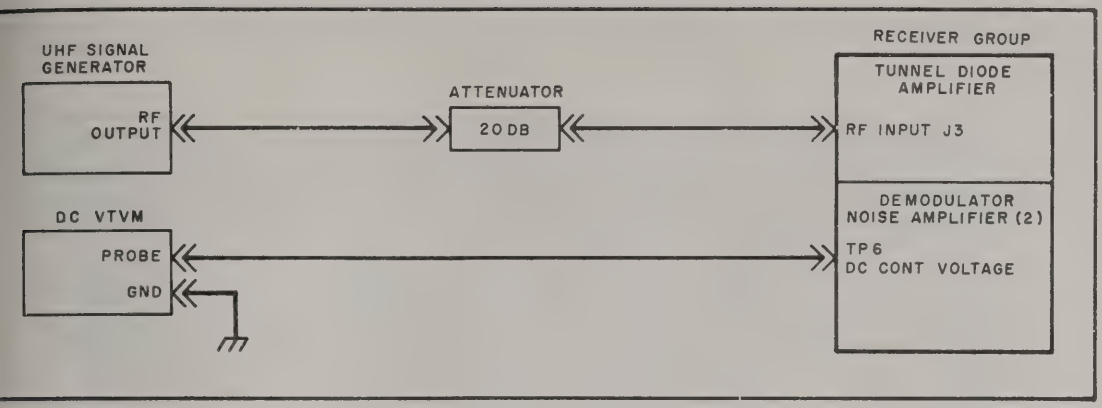


Figure 4-10. DC Control Voltage Test

e. If necessary, slightly adjust DC CONT VOLTAGE ADJ potentiometer R1 on the Noise Amplifier-Reflex and Recorder Amplifier for a level of -5.0 volts dc.

f. Measure and record the DC control voltage for each RF input Level (making up for cable and 20-db Attenuator losses) as specified in the table on figure 4-11A or 4-11B). (or figure 4-11C for type 1130A).

g. Check that the recorded data falls on or parallels (within the required limits) the DC control voltage characteristic curve associated with the channel capacity of the Receiver under test (figure 4-11A or 4-11B). (or figure 4-11C for Type 1130A).

h. If the requirements are not met, align the DC Control Voltage Circuit as described in paragraph F-5.

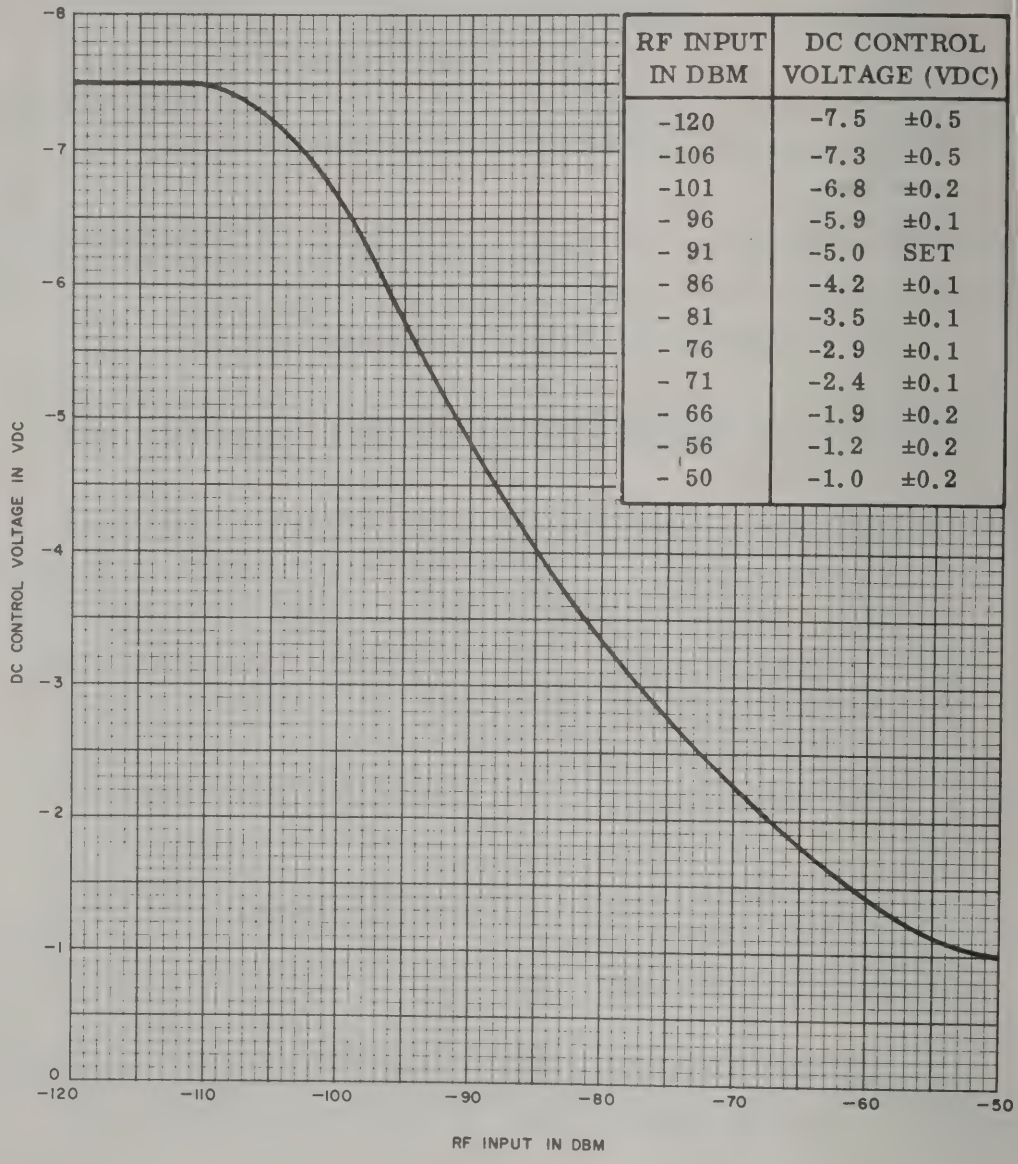
i. When all requirements have been met, remove all test equipment. Restore all cables and switches for normal operation.

. IF Bandwidth Test

The purpose of this test is to check the IF bandwidth of the Demodulator when ne Frequency Response, or Quieting characteristic tests do not meet their require-nents. A VHF Signal Generator, Frequency Counter, and RF Voltmeter with 50-ohm Probe are required for this test.

a. Using the Frequency Counter, set the VHF Signal Generator to 70 mc.

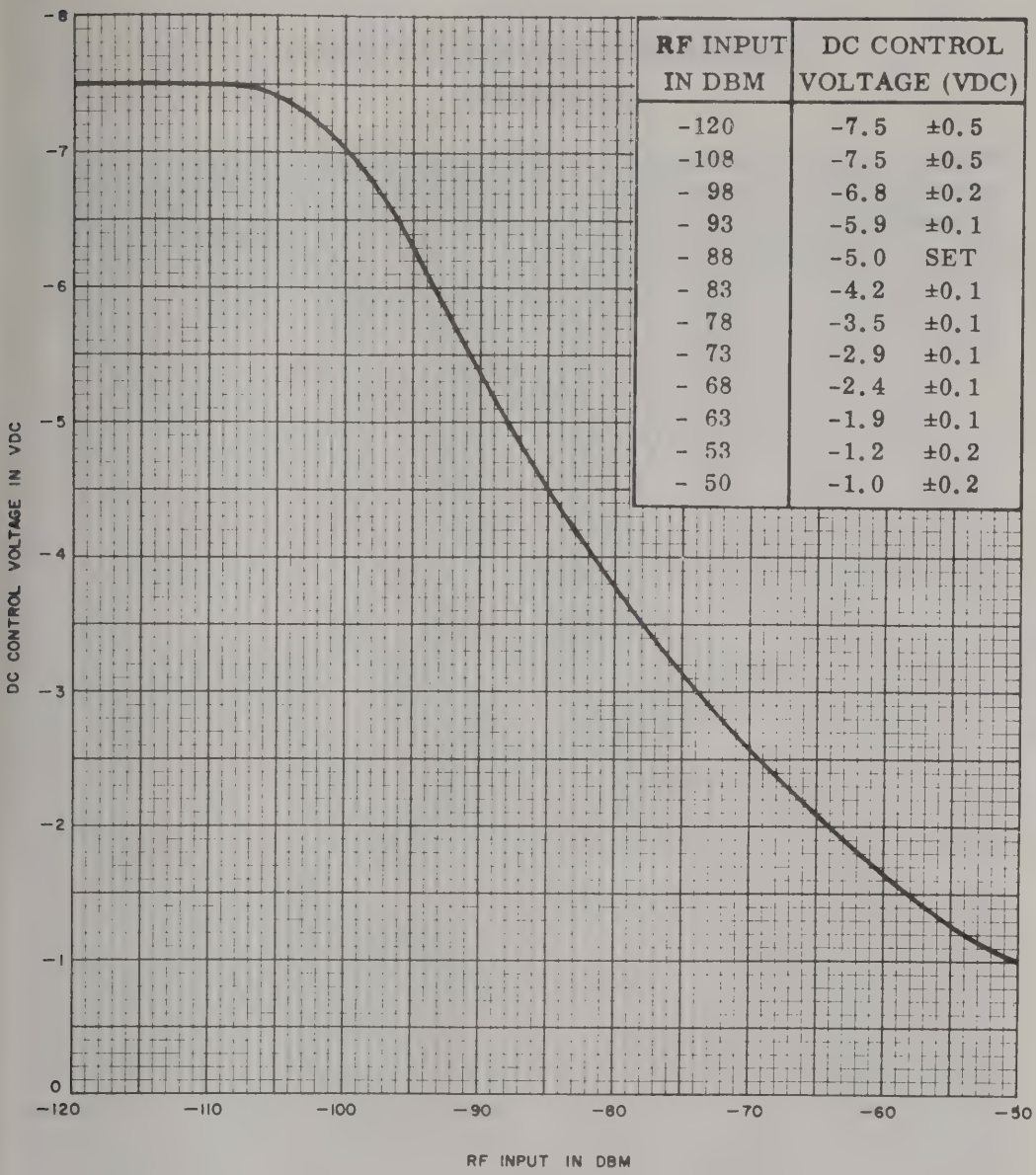
b. On IF Amplifier (1), connect the VHF Signal Generator to IF INPUT connector J1.



RF INPUT IN DBM	DC CONTROL VOLTAGE (VDC)
-120	-7.5 ±0.5
-106	-7.3 ±0.5
-101	-6.8 ±0.2
- 96	-5.9 ±0.1
- 91	-5.0 SET
- 86	-4.2 ±0.1
- 81	-3.5 ±0.1
- 76	-2.9 ±0.1
- 71	-2.4 ±0.1
- 66	-1.9 ±0.2
- 56	-1.2 ±0.2
- 50	-1.0 ±0.2

NOTES: TYPE 1130 RECEIVER, 72 CHANNELS MEASURED AT TUNNEL DIODE AMPLIFIER INPUT

Figure 4-11A. Typical 72-Channel DC Control Voltage Curve (Type 1130)



RF INPUT IN DBM	DC CONTROL VOLTAGE (VDC)
-120	-7.5 ±0.5
-108	-7.5 ±0.5
- 98	-6.8 ±0.2
- 93	-5.9 ±0.1
- 88	-5.0 SET
- 83	-4.2 ±0.1
- 78	-3.5 ±0.1
- 73	-2.9 ±0.1
- 68	-2.4 ±0.1
- 63	-1.9 ±0.1
- 53	-1.2 ±0.2
- 50	-1.0 ±0.2

NOTES: TYPE 1130 RECEIVER, 132 CHANNELS MEASURED AT TUNNEL DIODE AMPLIFIER INPUT

Figure 4-11B. Typical 132-Channel DC Control Voltage Curve (Type 1130)

TYPE 1130A RECEIVER

WITH

TYPE 1133 TUNNEL DIODE AMPLIFIER

72 CHANNELS

RF INPUT IN DBM	DC CONTROL VOLTAGE (VDC)
-120	-7.5 ±0.5
-106	-7.3 ±0.5
-101	-6.8 ±0.2
- 96	-5.9 ±0.1
- 91	-5.0 SET
- 86	-4.2 ±0.1
- 81	-3.5 ±0.1
- 76	-2.9 ±0.1
- 71	-2.4 ±0.1
- 66	-1.9 ±0.2
- 56	-1.2 ±0.2
- 50	-1.0 ±0.2

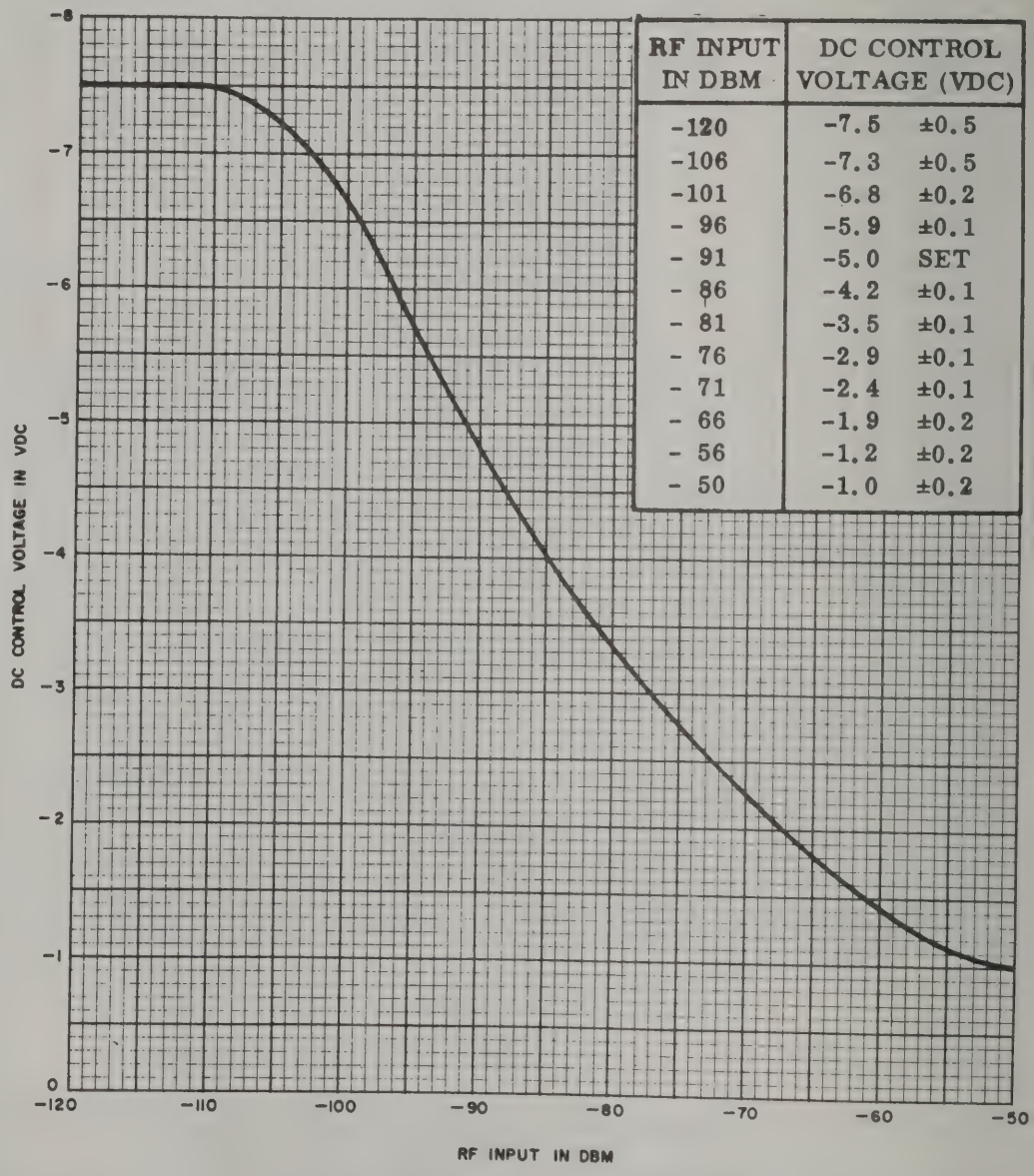


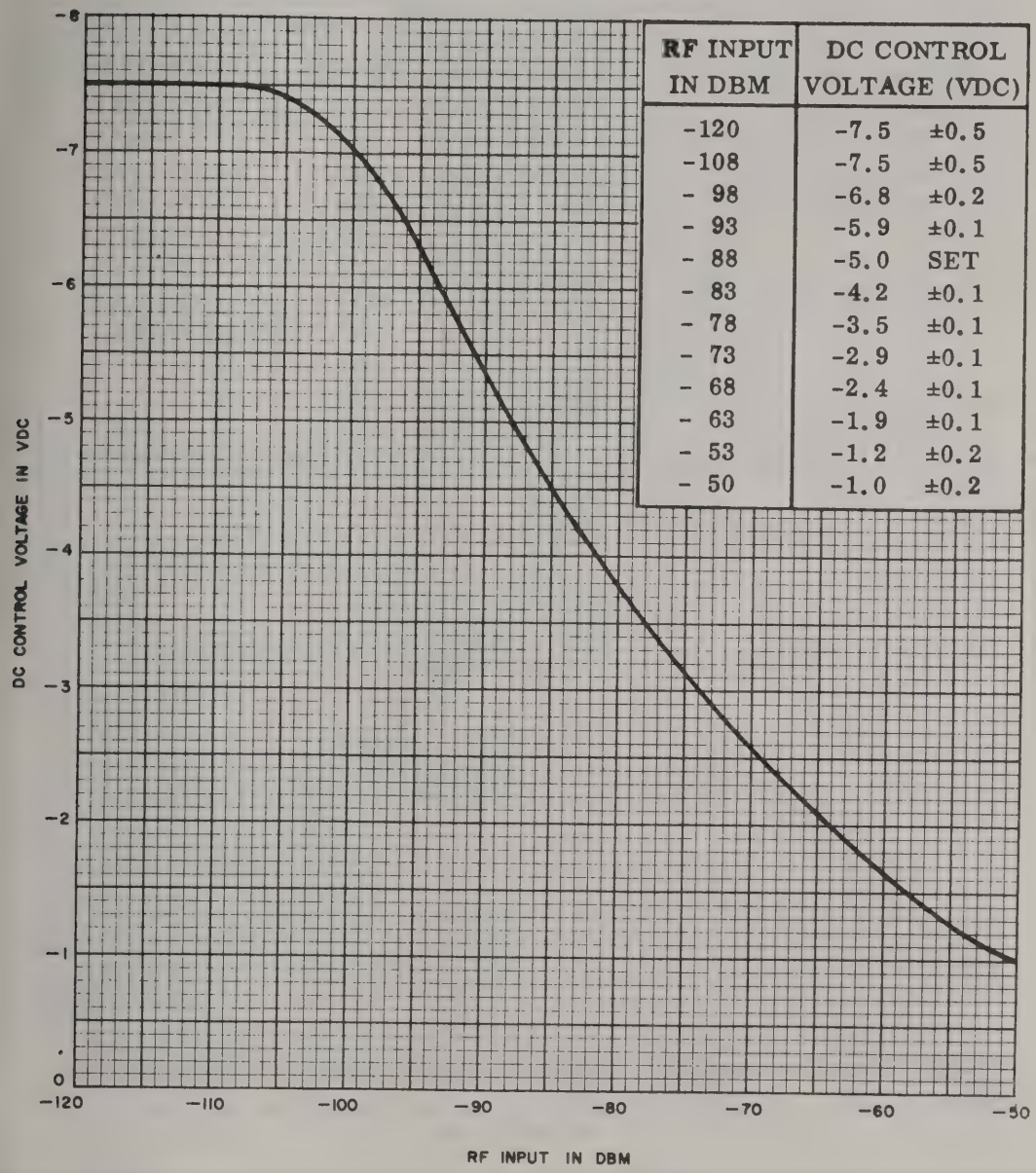
Figure 4-11A.1. Typical 72-Channel DC Control Voltage Curve (Type 1130A)

TYPE 1130A RECEIVER

WITH

TYPE 1133 TUNNEL DIODE AMPLIFIER

132 CHANNELS



RF INPUT IN DBM	DC CONTROL VOLTAGE (VDC)
-120	-7.5 ±0.5
-108	-7.5 ±0.5
- 98	-6.8 ±0.2
- 93	-5.9 ±0.1
- 88	-5.0 SET
- 83	-4.2 ±0.1
- 78	-3.5 ±0.1
- 73	-2.9 ±0.1
- 68	-2.4 ±0.1
- 63	-1.9 ±0.1
- 53	-1.2 ±0.2
- 50	-1.0 ±0.2

Figure 4-11B.1. Typical 132-Channel DC Control Voltage Curve (Type 1130A)

TYPE 1130A RECEIVER

WITH

TYPE 1133 TUNNEL DIODE AMPLIFIER

252 CHANNELS

RF INPUT IN DBM	DC CONTROL VOLTAGE (VDC)
-110	-7.5 ±0.5
-100	-7.3 ±0.5
- 95	-6.8 ±0.2
- 90	-5.9 ±0.1
- 85	-5.0 SET
- 80	-4.2 ±0.1
- 75	-3.5 ±0.1
- 70	-2.9 ±0.1
- 65	-2.4 ±0.1
- 60	-1.9 ±0.1
- 50	-1.2 ±0.2

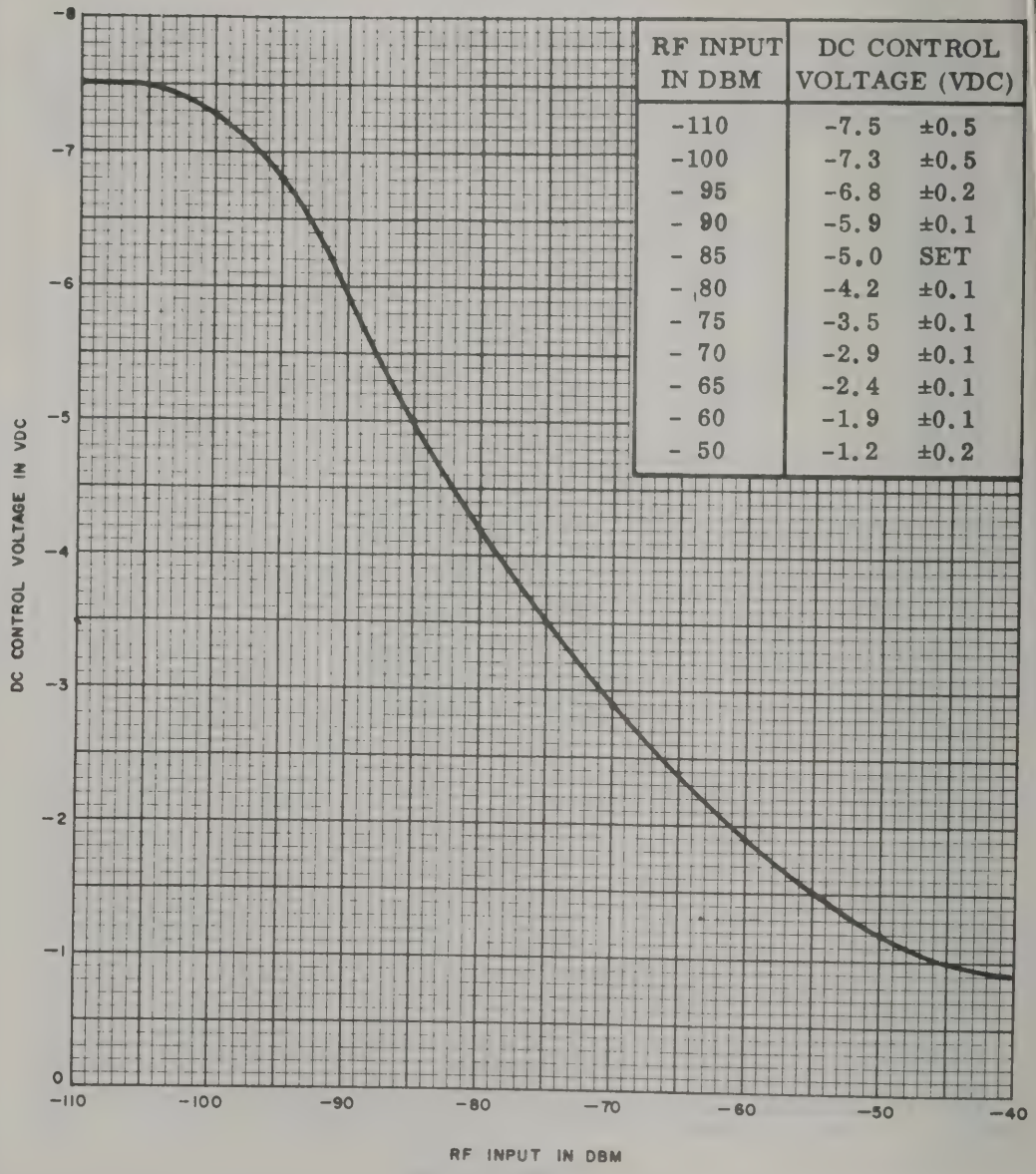


Figure 4-11C.1. Typical 252-Channel DC Control Voltage Curve (Type 1130A)

c. On IF Amplifier (2), connect the RF Voltmeter with 50Ω Probe to COMP LIM connector J4.

d. Adjust the VHF Signal Generator output for a reference level of 100 mv rms on the RF Voltmeter.

e. Maintaining a constant Signal Generator output level, increase the frequency of the VHF Signal Generator until the RF Voltmeter indicates a drop of 3 db from the reference level (step d).

f. Using the Frequency Counter, measure and record the high frequency at the 3-db point.

g. Maintaining a constant Signal Generator output level, decrease the VHF Signal Generator frequency until the RF Voltmeter returns to the reference level and again drops 3 db.

h. Using the frequency counter, measure and record the low frequency of the 3-db bandwidth.

i. Subtract the low frequency (step h) from the high frequency (step f) to obtain the overall 3 db IF bandwidth. The requirement is as follows: 72 Channels (PF1425) 3 mc ±10% or 132 Channels (PF1394) 6 mc ±10%. (Or 252 Channels (PF1392) ±10%).

j. If the requirement is not met, check the IF Filter alignment. Refer to paragraph F-4d.

k. If the requirement is still not met, check IF Amplifier (1) and/or IF Amplifier (2) and recheck the bandwidth. Refer to paragraphs F-4b and F-4c).

l. When all requirements have been met, remove all test equipment. Restore all cables and switches for normal operation.

. RF Gain and Bandwidth Test

The purpose of this test is to determine that the gain and bandwidth of the Frequency Converter and Tunnel Diode Amplifier are satisfactory. A Frequency Meter, UHF Signal Generator, 20-db Attenuator, and RF Voltmeter are required for this test.

a. Using the Frequency Meter, set the Signal Generator to the assigned Receiver operating frequency. Detune the Frequency Meter off center frequency.

b. Connect the equipment as shown in figure 4-12.

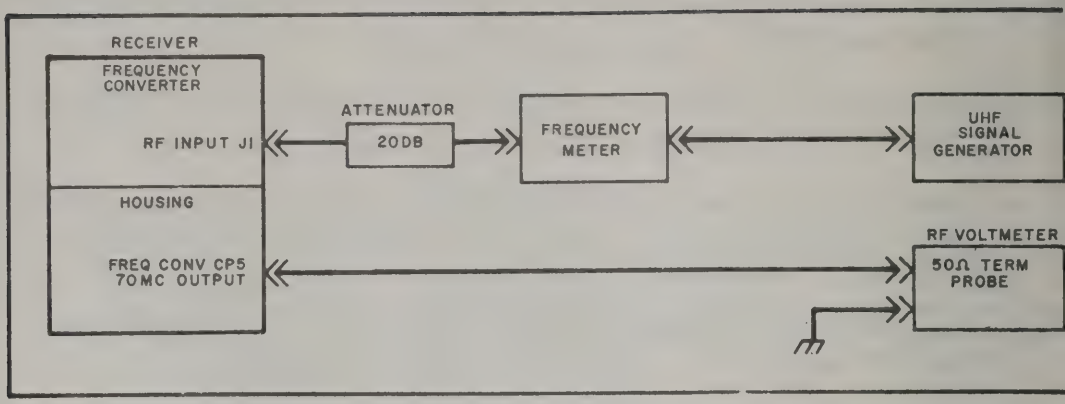


Figure 4-12. RF Gain and Bandwidth Test

c. Set the UHF Signal Generator level for an RF input level of -40 dbm (allowing for cable and 20-db Attenuator losses).

d. The gain of the Frequency Converter should be 26 to 32 db. If the limi can not be met, check the alignment of the Mixer and IF Preamplifier (paragraph G-4).

e. If the requirement of step d is met, proceed as follows:

(1) Maintaining a constant Signal Generator output level, increase the frequency until the indication on the RF Voltmeter decreases by 1.0 db.

(2) With the Frequency Meter, measure the RF frequency as observed by a dip on the RF Voltmeter.

(3) Maintaining a constant Signal Generator output level, return the frequency until the Frequency Meter indicates the carrier frequen Decrease the Signal Generator frequency until the reference level again decreases by 1.0 db.

(4) With the Frequency Meter, measure the RF frequency as observed a dip on the RF Voltmeter.

(5) Subtract the lower frequency from the higher frequency to obtain t -1 db bandwidth. The -1.0 db bandwidth should be 20±3 mc.

(6) Repeat steps (1) through (5) for the ±3 db points. The -3.0 db ban width should be 26±6 mc.

f. If the requirements for the 1 and 3 db bandwidth are not met, then check the alignment of the Mixer and IF Preamplifier (paragraph F-4).

g. Using the same test setup (figure 4-12), connect the Tunnel Diode Amplifier between the Frequency Converter and the 20-db Attenuator.

h. Reset the Signal Generator to the assigned RF frequency and reduce the input level until the IF input to the Demodulator is the same as in step d.

i. The difference in the RF input levels in step c and this step is the gain of the Tunnel Diode Amplifier. The gain should be 17 ±2 db. If the limits can not be met, refer to the TDA Tuning and Alignment Procedure Paragraph M.

j. Repeat steps e(1) through e(5) to determine that the Tunnel Diode Amplifier is at least capable of the bandwidth established by the Frequency Converter. If the 1 and 3 db bandwidths are not met, refer to the TDA Tuning and Alignment Procedure Paragraph M.

k. When all requirements have been met, remove all test equipment and restore all cables for normal operation.

. Demodulator Transfer Characteristic Test (Type 1130 Only).

The purpose of this test is to determine that the Demodulator Transfer Circuit is operating properly. A UHF Signal Generator is required for this test.

a. Set COMBINER DEFEAT switch S1, RAD PLT DEFEAT switch S2, and NOISE AMPL DEFEAT switch S3 to DEFEAT.

b. Connect the UHF Signal Generator to the RF INPUT connector J1 on the Tunnel Diode Amplifier.

c. Set the UHF Signal Generator frequency for the assigned RF frequency of the Receiver at an RF input level to the Tunnel Diode Amplifier of -70 dbm (50Ω).

d. Set THRESHOLD EXT DEFEAT switch S4 to NORM and check that THRESHOLD EXT IN lamp DS5 is off.

e. Slowly decrease the RF input level to the equipment until THRESHOLD EXT IN lamp DS5 goes on. Taking into consideration cable attenuation, measure the input level to the Tunnel Diode Amplifier.

NOTE: The lower transfer limit for 72-channel operation should take place when the level to the Tunnel Diode Amplifier is -88 dbm.

f. Slowly increase the RF input level until THRESHOLD EXT IN lamp DS5 goes off. Taking into consideration cable attenuation, measure the input level to the Tunnel Diode Amplifier.

NOTE: The upper transfer limit for 72-channel operation should take place when the level to the Tunnel Diode Amplifier is from -88 to -85 dbm.

g. If the lower or upper transfer limits are not met, reset TRANSFER ADJ potentiometer R17 on the Transfer Module until both limits are met.

10. RF Preselector Tests

The purpose of these tests is to determine that the RF preselector is operating properly.

a. Insertion Loss Test

A Signal Generator, a well calibrated Frequency Meter, a 10-db RF Attenuator and a Microwave Power Meter with a Thermistor Mount are required for this procedure.

(1) Connect the output of the Signal Generator through the Frequency Meter and 10-db Attenuator to the input of the RF Preselector.

(2) Connect the output of the RF Preselector through the Thermistor Mount to the Microwave Power Meter.

(3) Using the Frequency Meter, set the Signal Generator to the assigned RF carrier frequency of the RF Preselector and the output level for a convenient reference level as indicated on the Microwave Power Meter.

(4) Connect the Signal Generator directly through the Frequency Meter, 10-db Attenuator and Thermistor Mount to the Microwave Power Meter. The increase in the indication from the reference in step (3) should not exceed 0.8 db.

(5) If the requirement for insertion loss is not met, align the RF Preselector (paragraph j).

(6) If the requirement has been met, remove all test equipment, and restore the RF Preselector to service.

b. Bandwidth Test

A Signal Generator, a well calibrated Frequency Meter, a 10-db RF Attenuator and a Microwave Power Meter with Thermistor Mount are required for this procedure.

(1) Connect the output of the Signal Generator through the Frequency Meter and 10-db Attenuator to the input of the RF Preselector.

(2) Connect the output of the RF Preselector to the Thermistor Mount on the Microwave Power Meter.

(3) Using the Frequency Meter, set the Signal Generator to the assigned RF carrier frequency of the RF Preselector and the output for a convenient reference level as indicated on the Microwave Power Meter.

(4) Tune the Signal Generator to either side of the RF carrier frequency in order to determine the two points at which the Microwave Power Meter indicates a reduction of 3 db from the reference in step (3).

(5) Using the Frequency Meter, measure and record the frequency at the 3-db points.

(6) Subtract the lower frequency from the higher frequency to determine the bandwidth.

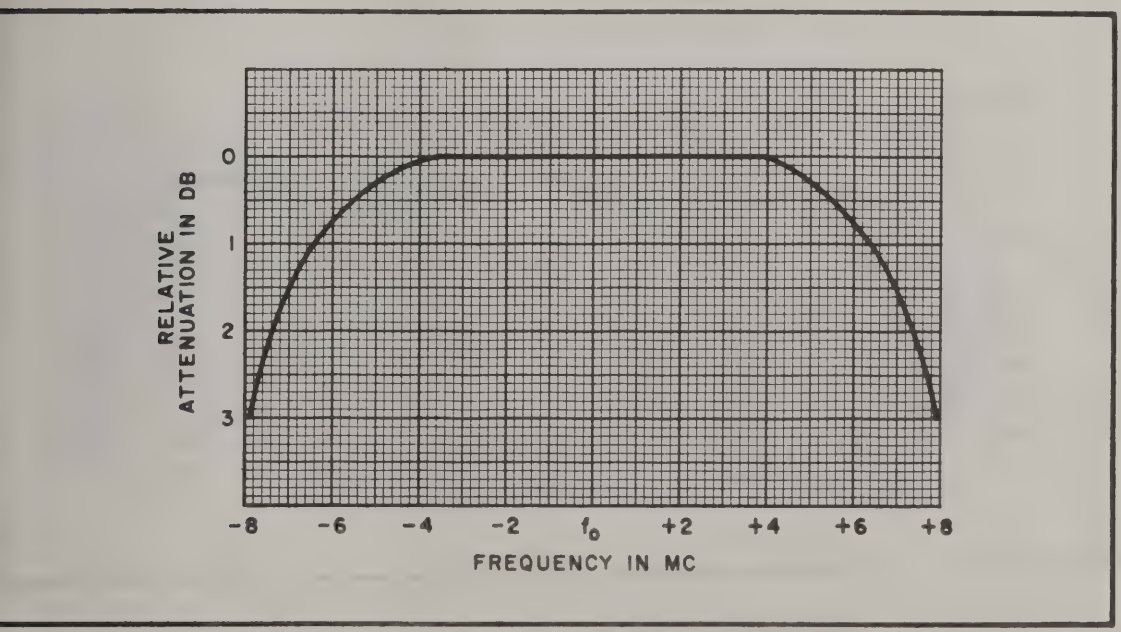


Figure 4-13. RF Preselector Typical Bandwidth Curve

(7) If the bandwidth between the 3-db points is less than 15 mc (figure 4-13), realign the RF Preselector (paragraph j).

(8) If the requirement has been met, remove all test equipment and restore the RF Preselector to service.

c. VSWR Test

A Signal Generator, a Frequency Counter, Slotted Line, VSWR Indicato 10-db RF Attenuator and 50-ohm Termination (1.7 to 2.4 GC) are required for this procedure.

(1) Connect the equipment as shown in figure 4-14.

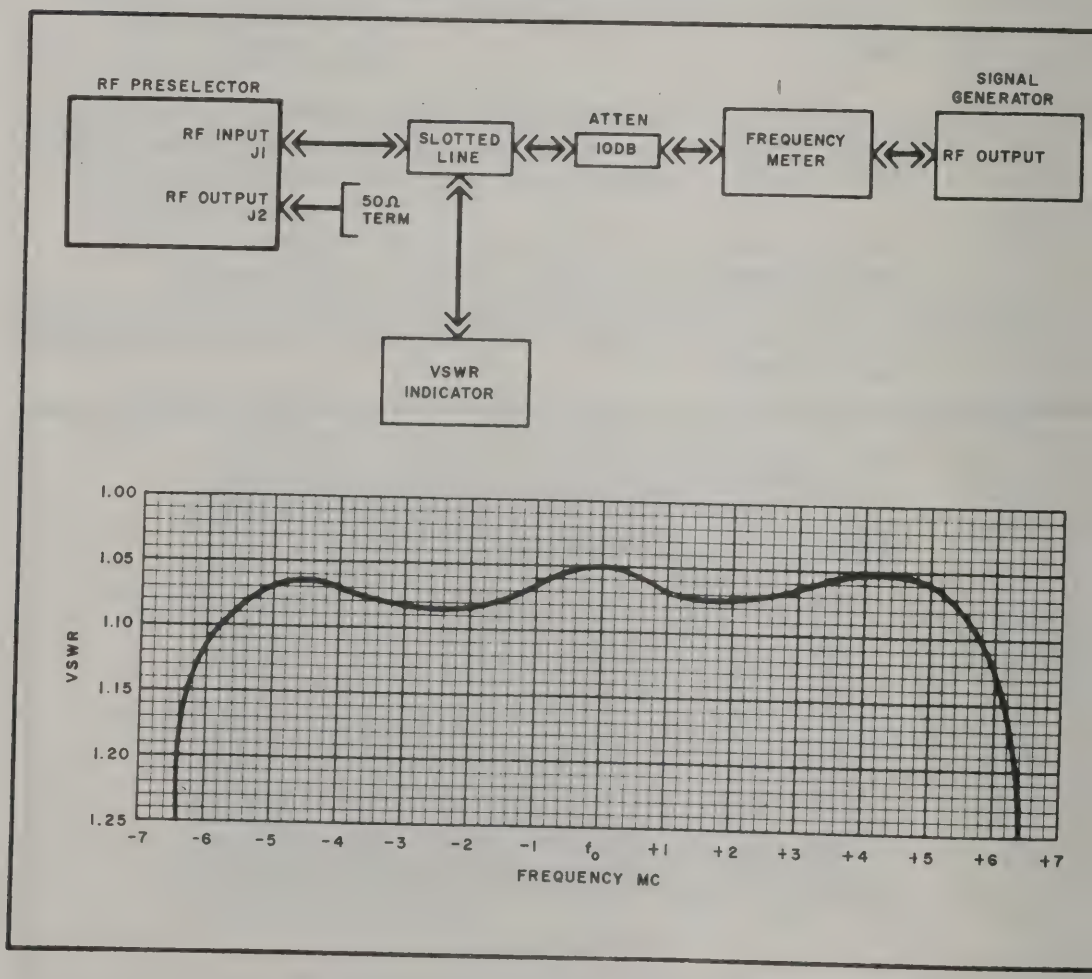


Figure 4-14. RF Preselector VSWR Test

(2) Measure the VSWR at the assigned RF carrier frequency of the RF Preselector.

(3) Measure the VSWR at 4 mc either side of the carrier.

(4) If the VSWR is greater than 1.2:1 (figure 4-14) in any of these three measurements, realign the RF Preselector (paragraph j).

F. DEMODULATOR TEST AND ALIGNMENT PROCEDURES

Alignment procedures are performed when the requirements of a performan test are not met and the trouble indicated may be due to alignment or adjustment of circuit components. All alignment procedures are performed with the equipment ou of service. See figure 4-15 for the location of test point and adjustment controls in Demodulator Drawer.

Some procedures are most easily performed on a system basis, with a Mode that has been checked and is operating properly. The most accessible and convenie test points should be chosen for injecting and measuring test tones and signals. The test setups in these procedures recognize the functional points for connections, not necessarily the most convenient points. The arrangement of the equipment and the availability of central patching and monitoring facilities at the site dictate the most convenient points to connect test equipment for system tests.

1. Baseband Level and Frequency Response Test and Adjustment

The purpose of this procedure is to adjust the baseband levels and the frequency response when the requirements of the performance test are not met. An Oscillator, AC VTVM with Probe, VTVM, Modem and 10-db Attenuator are require for this procedure.

NOTE: If a Modem is not available, an REL Exciter that has been thoroughly checke and is operating properly can be substituted. Refer to the Exciter Instructio Manual for circuit connections.

a. On the Modem:

(1) Deactivate the Radio Pilot circuit on the Modem's Test Exciter by connecting the shorting cap P40 to RADIO PILOT DEFEAT jack J32.

(2) Set the CHAN CAPACITY SELECTOR switch S5 to the position representing the channel capacity of the system under test.

b. On the Demodulator, set COMBINER DEFEAT switch S1, RADIO PILOT DEFEAT switch S2, and NOISE AMPL PILOT DEFEAT switch S3 and THRESHOLD EXT DEFEAT switch S4 to DEFEAT. (S4 not used on Type 1130A).

c. Connect the equipment as shown in figure 4-4 (option 3).

d. Set the Oscillator for 20 kc at a baseband output level of -45 dbm.

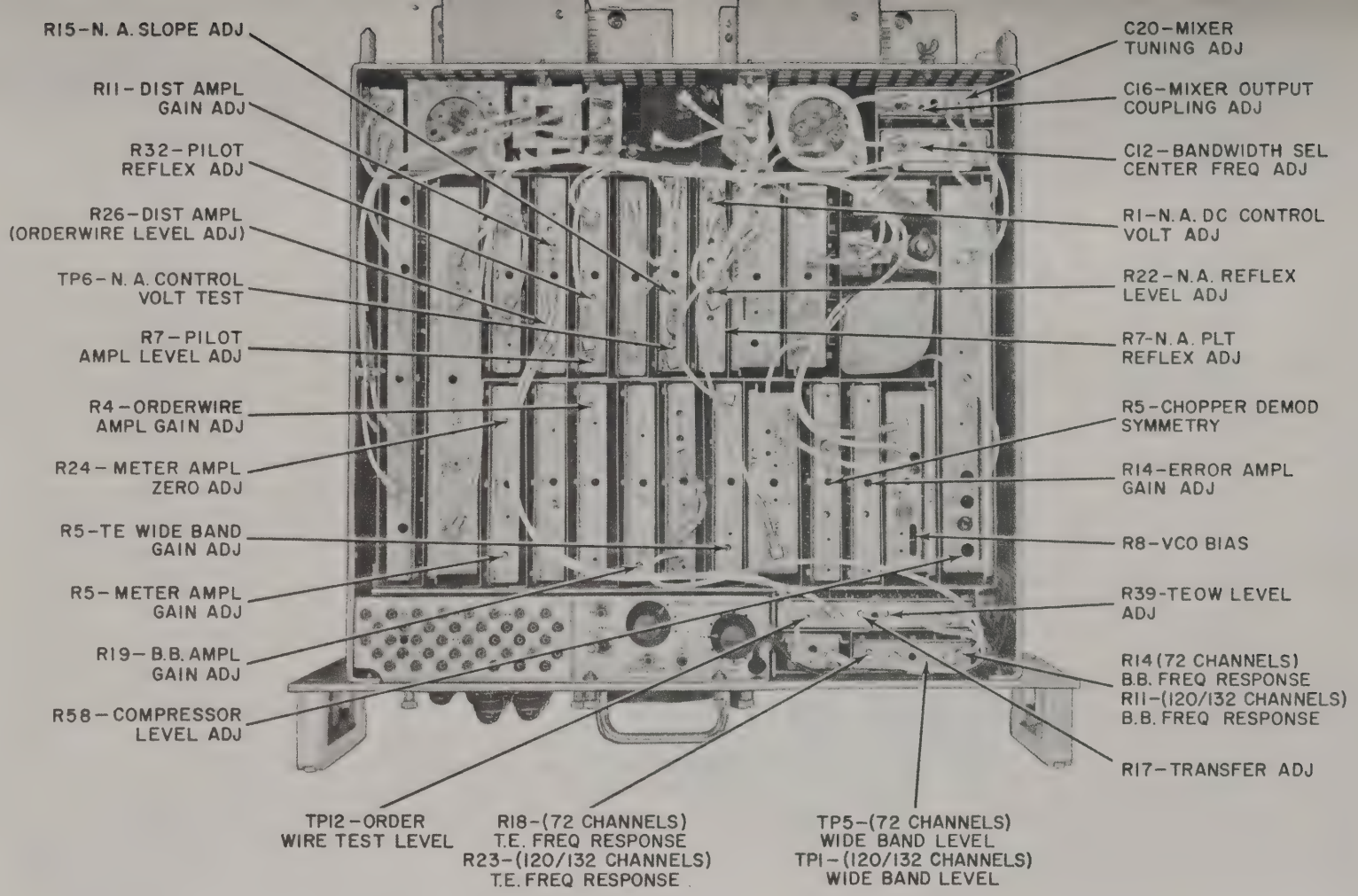
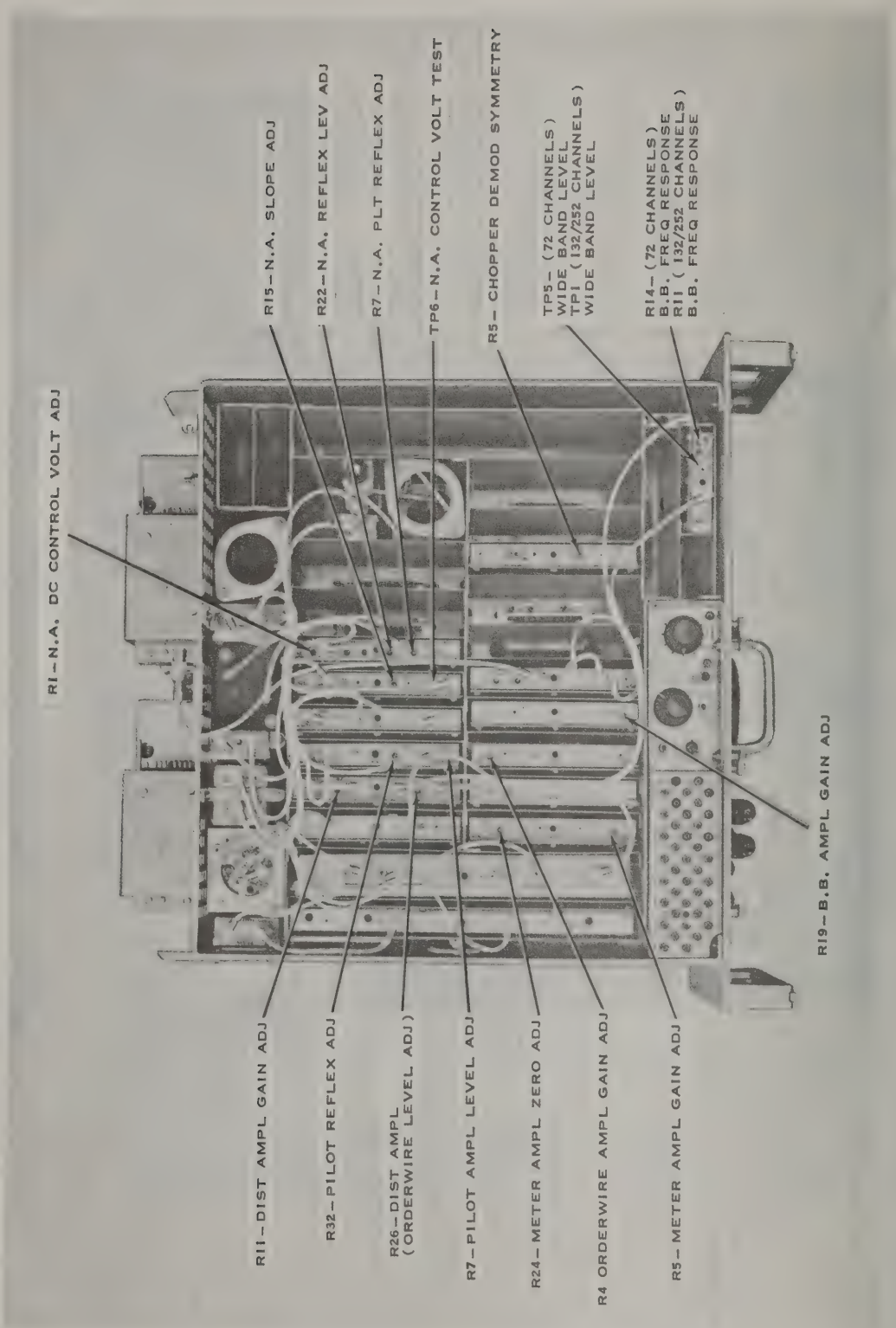


Figure 4-15. Demodulator Drawer Test Points and Adjustments (Type 1130)


R1-N.A. DC CONTROL VOLT ADJ
R15-N.A. SLOPE ADJ
R22-N.A. REFLEX LEV ADJ
R7-N.A. PLT REFLEX ADJ
TP6-N.A. CONTROL VOLT TEST
R5- CHOPPER DEMOD SYMMETRY
TP5- (72 CHANNELS)
WIDE BAND LEVEL
TP1 (132/252 CHANNELS)
WIDE BAND LEVEL
R14- (72 CHANNELS)
B.B. FREQ RESPONSE
R11 (132/252 CHANNELS)
B.B. FREQ RESPONSE
R19-B.B. AMPL GAIN ADJ
R11-DIST AMPL GAIN ADJ
R32-PILOT REFLEX ADJ
R26-DIST AMPL
(ORDERWIRE LEVEL ADJ)
R7-PILOT AMPL LEVEL ADJ
R24-METER AMPL ZERO ADJ
R4 ORDERWIRE AMPL GAIN ADJ
R5-METER AMPL GAIN ADJ

e. On the Channel Capacity Selector located on the Demodulator drawer, connect the probe of an AC VTVM to test point TP5 for 72 channels and TP1 for 132 channels, or 252 Channels.

f. On the Distribution Amplifier located on the Demodulator drawer; if necessary, adjust AMPL GAIN CONTROL potentiometer R11 for an indication of 15.5 mv rms on the AC VTVM. If the requirement is not met, check the FM Detector sensitivity, the Distribution Amplifier and the Emitter-Follower on the FM Detector (refer to paragraph F-4).

g. Set THRESHOLD EXT DEFEAT switch S4 to TEST. The AC VTVM should still indicate 15.5 mv rms. If necessary, adjust GAIN potentiometer R5 on the Wideband Amplifier until the requirement is met. Reset switch S4 to DEFEAT. (TYPE 1130 Only)

h. Disconnect the Oscillator from the Modem. The baseband output level should decrease by at least 20 db. If this requirement is not met, check for excessive noise in the Demodulator.

i. Reconnect the Oscillator to the Modem. Keeping the Oscillator output level constant, change the frequency to 60 kc.

j. Check that the BB OUTPUT ATTENUATOR (23560) on the Demodulator is set to NORM. If necessary, set GAIN ADJ potentiometer R19 on the Baseband Amplifier for a baseband output level of -15 dbm.

k. Keeping the Oscillator output level constant, increase the frequency to the high end of the baseband range; for 72 channels 300 kc or 132 channels 552 kc, and 252 Channels 1052 kc.

l. On the Channel Capacity Selector Card; if necessary, adjust the deemphasis potentiometer R14, for 72 channels and R11 for 132 or 252 channels for a level as close as possible to that in step i.

m. Set THRESHOLD EXT DEFEAT switch S4 to TEST. The indication on the AC VTVM should be the same as in step l. If necessary, adjust the Threshold-Extension Frequency Equalizer potentiometer (72 channels- R18) or (132 channels - R23) until the requirement is met. (Type 1130 only)

n. Reset switch S4 to DEFEAT and set the Oscillator for 60 kc at -45 dbm. (Type 1130 only).

o. If necessary, reset GAIN ADJ potentiometer R19 on the Baseband Amplifier for the baseband output level in step j.

p. Check the overall frequency response as specified in paragraph E-1, step j.

q. Remove all test connections; restore all cables and switches for normal operation.

2. Order Wire Level Test and Adjustment

The purpose of this procedure is to adjust the order wire levels in the Demodulator when the requirements of the performance test are not met. An Oscillator, AC VTVM with Probe, VTVM, Modem and 10-db Attenuator are required for this procedure.

NOTE: If a Modem is not available, an REL Exciter that has been thoroughly checked and is operating properly can be substituted. Refer to the Exciter Instruction Manual for circuit connections.

a. On the Modem:

(1) Deactivate the Radio Pilot circuit on the Test Exciter by connecting the shorting cap P40 to RADIO PILOT DEFEAT jack J32.

(2) Set the CHAN CAPACITY SELECTOR switch S5 to the position representing the channel capacity of the system under test.

b. On the Demodulator, set COMBINER DEFEAT switch S1, RADIO PILOT DEFEAT switch S2, NOISE AMPL PILOT DEFEAT switch S3 and THRESHOLD EXT DEFEAT switch S4 to DEFEAT. (S4 used on Type 113 only)

c. Connect the equipment as shown in figure 4-5, option 3.

d. Set the Oscillator for 1 kc and the order wire input level to -30 dbm.

e. On the Transfer Module, connect the probe of the AC VTVM to test point TP12. The indication should be 4 mv rms. If necessary, adjust ORDER WIRE GAIN potentiometer R26 on the Distribution Amplifier to meet the requirement. (Type 1130 only)

f. Set THRESHOLD EXT DEFEAT switch S4 to TEST. The indication on the AC VTVM should still be 4 mv rms. If necessary, adjust ORDER WIRE LEVEL potentiometer R39 on the Transfer Module to meet the requirement. (Type 1130 only)

g. Set switch S4 to DEFEAT. (Type 1130 only)

h. On the Order Wire Amplifier, connect the probe of an AC VTVM to test point TP1.

i. If necessary, set ORDER WIRE GAIN ADJ potentiometer R26 for an indication of 2 mv.

j. If necessary, set GAIN ADJ potentiometer R4 on the Order Wire Amplifier for an order wire output level on the VTVM of -15 dbm.

k. Remove all test equipment; restore all cables and switches for normal operation.

Group Delay and Linearity Adjustment of Driver-Discriminator.

OTE: There exists an accumulative effect of Group Delay due to the Down Converter, IF Circuits, and Compressor-Limiter. Since it is desirable to keep the overall Exciter-Receiver-Power Amplifier delay to less than 8 nsec (12 nsec may still permit realization of 55 db NPR), it is important to realize that the IF filter is actually being used to equalize the excess group delay. It is important to first check the Driver-Discriminator and then proceed to the overall IF section test.

The purpose of this procedure is to align the Driver-Discriminator for optimum nearity and phase delay when requirements for the intermodulation distortion test are ot met. A Delay and Linearity Test Transmitter and Test Receiver, an Oscilloscope, HF Signal Generator, DC VTVM, and a 75-Ohm to 50-Ohm Impedance Matching Net- ork are required for this procedure.

OTE: Check Delay and Linearity setup on a back-to-back basis (paragraph F-4a) before proceeding.

a. Connect the VHF Signal Generator to IF INPUT connector J1 on the Compressor-Limiter.

b. Set the frequency of the VHF Signal Generator for a 70-mc marker frequency.

c. Connect the DC VTVM to DISCR TEST point TP1 on the Driver-Discriminator and adjust if necessary, SECONDARY ADJ capacitor C9 for zero volts (crossover).

d. Connect equipment as shown in figure 4-16. See figure 4-17 for controls on the Driver-Discriminator.

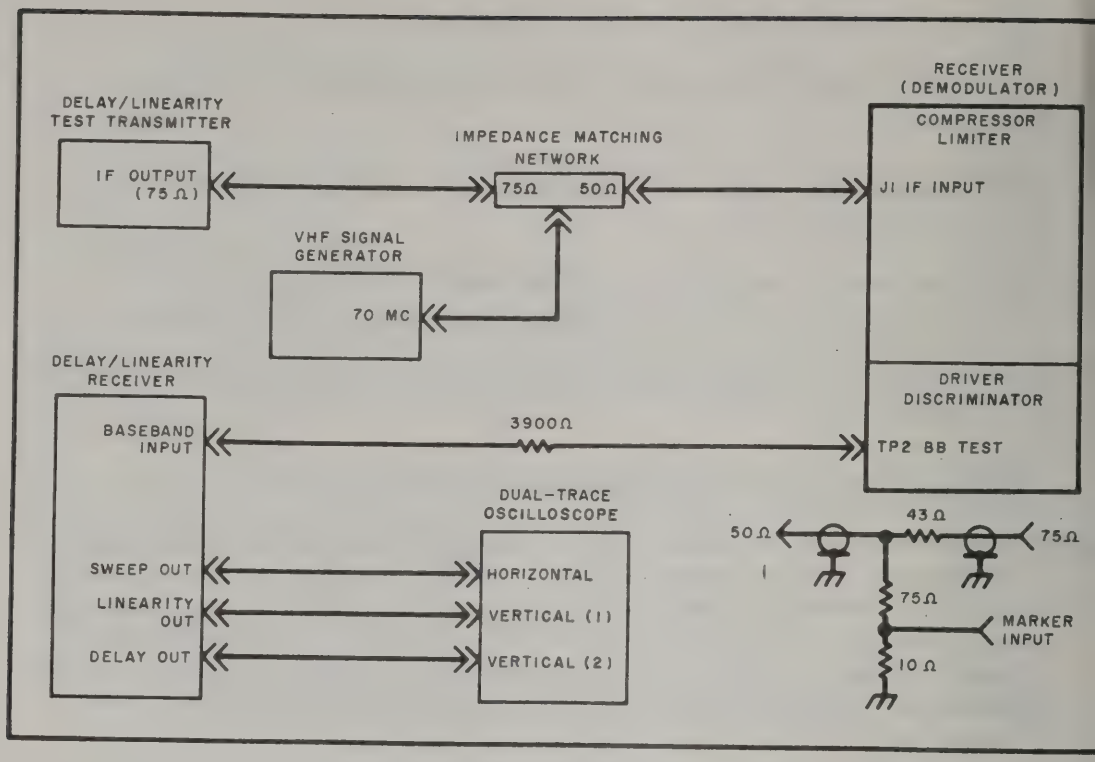


Figure 4-16. Group Delay and Linearity Adjustment

e. Calibrate the linearity trace by depressing the LINEARITY CALIBRATE 2% switch and observing the separation between the two linearity traces. The scope gain can be adjusted for any convenient amount of separation.

f. Calibrate the delay trace by depressing the DELAY CALIBRATE -10 mμ s switch and observing the separation between the two delay traces for 10 nanoseconds. The scope gain can be adjusted for any convenient amount of separation.

g. Adjust the 200 kc IF DEV potentiometer for minimum noise on the scope; however, the linearity and delay traces should be recalibrated each time this is done.

h. If necessary, adjust PRIM ADJ capacitor C7 in conjunction with the Primary Loading ADJ potentiometer R4 on the Driver-Discriminator for a balanced peak-to-peak linearity response of 0.5% nonlinearity maximum around the 70-mc marker frequency and a group delay of 3 nanoseconds maximum; at ±1 mc deviation for 72 channels or at ±1.5 mc deviation for 132 channels, and at ±2.5 mc deviation for 252 channels.

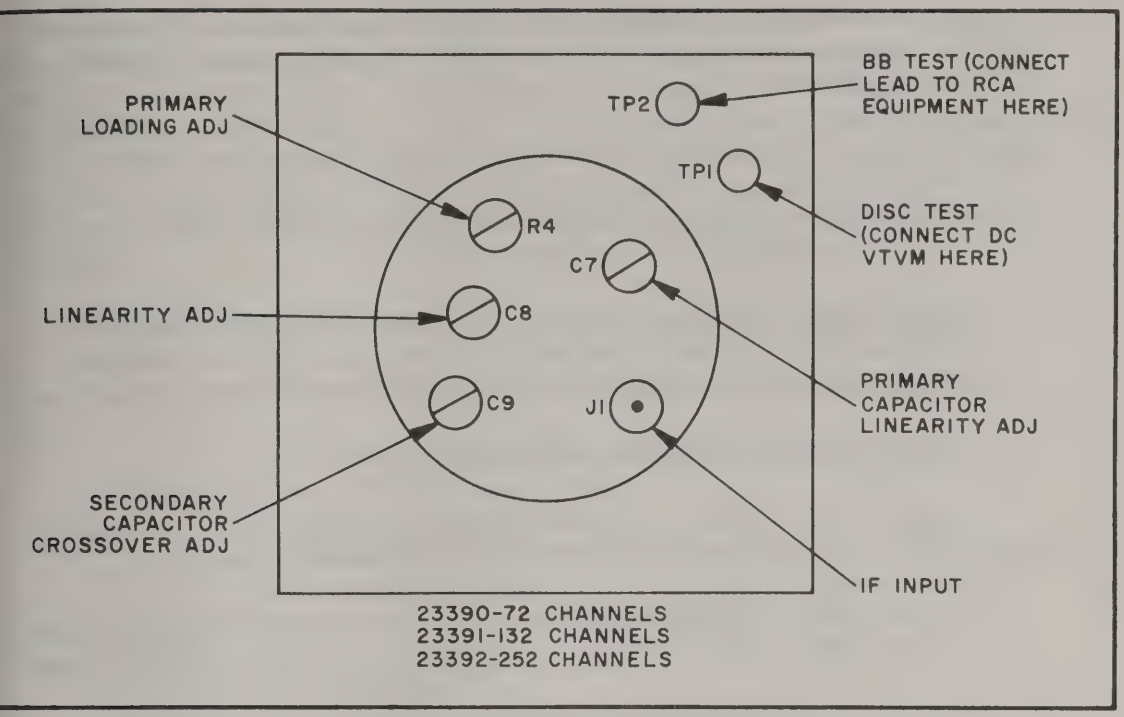


Figure 4-17. Driver-Discriminator Controls

i. If the requirement of step h is met, reconnect the equipment as in step a and, if necessary, readjust SECONDARY ADJ capacitor C9 on the Driver-Discriminator for zero (crossover).

j. If the linearity requirement of step h is met while the delay requirement of step h is not met proceed as follows:

(1) Connect the equipment as shown in figure 4-16.

(2) Connect a DC VTVM to DISCR TEST point TP1 on the Driver-Discriminator and observe the DC voltage with the Delay and Linearity Test Transmitter as a driving source. Record this voltage for future reference.

(3) On the Driver-Discriminator, set the LINEARITY ADJ control C8 at fully counterclockwise position and readjust SECONDARY ADJ capacitor C9 for same voltage as observed in step (2).

(4) Readjust if necessary, the PRIMARY LOADING ADJ potentiometer R4 in conjunction with PRIM ADJ capacitor C7 for optimum performance as specified in step j.

(5) If necessary, repeat steps (3) and (4) advancing in small increments with capacitor C8 in a clockwise direction until optimum performance is obtained.

(6) If the requirement of step h is met, repeat step i.

(7) If the requirement of step h is not met, replace the Driver-Discriminator and recheck performance.

k. With the equipment connected as in step a and the DC VTVM to DISCR TEST point TP1 on the Driver Discriminator, start at 70 mc and vary the frequency of the Signal Generator in 1-mc steps between 67 and 73 mc.

l. Calculate the Discriminator sensitivity as follows:

$$\text{Sensitivity} = \frac{\text{Change in detected DC output voltage at TP1}}{\text{Change in IF frequency into the Discriminator}} \times 0.707$$

m. The requirement is approximately (within ±20%): 400μv/kc for 72 channels or 280μv/kc for 132 channels , and 160 micro-volts/kc for 252 channel

n. If the requirements of step m cannot be met, replace the Driver-Discriminator and recheck performance.

4. IF Amplifier Section Test and Alignment Procedure

NOTE: The procedure that follows is used only after the following was established:

(a) System intermodulation measurements confirmed that the IF of the Receiver (Demodulator Drawer) is deteriorating system performance beyond the required limits.

(b) The IF Amplifier section, consisting of IF Amplifier (1), Linear Phase Filter PF ( ) and IF Amplifier (2), was bypassed, by applying the signal from the Receiver Converter directly to the input of the Compressor Limiter. This establishes that it is the IF Amplifier section of the Demodulator producing excessive intermodulation distortion.

(c) Delay and Linearity measurements of the IF Amplifier section over the specified bandwidth was performed and established that the delay and linearity requirements as specified in paragraph F3 were not met.

a. IF Amplifier Section Group Delay and Linearity Test

The purpose of this procedure is to check and, if necessary, align the IF Amplifier section of the Receiver for optimum linearity and phase response when the requirements for the intermodulation distortion test are not met. A Delay and

nearity Test Transmitter and Receiver, and an RCA Demodulator (M1-24351-E) th a Phase Equalizer which have been previously tested back-to-back, and are pable of a symmetrical delay of one nanosecond maximum and a symmetrical nearity of 0.5 percent maximum over a minimum of plus and minus three mega- cles, are required for this procedure. In addition, a Dual-Trace Oscilloscope, VHF Signal Generator, two 75-Ohm Impedance Matching Networks, a 20-db tenuator, a 10-db Attenuator, and a IF Amplifier (HP-461A) are required for this ocedure.

(1) Back-to-Back Delay and Linearity Equipment Measurement

(a) Set up the equipment as in Figure 4-18, part A or part B.

(b) Check out the test equipment as per applicable notes in Figure 4-18, Sheets 1 and 2.

(c) Requirements: Symmetrical delay of one nanosecond maximum and symmetrical linearity of 0.5 percent maximum over a minimum of plus and minus three megacycles.

(2) Delay and Linearity Test

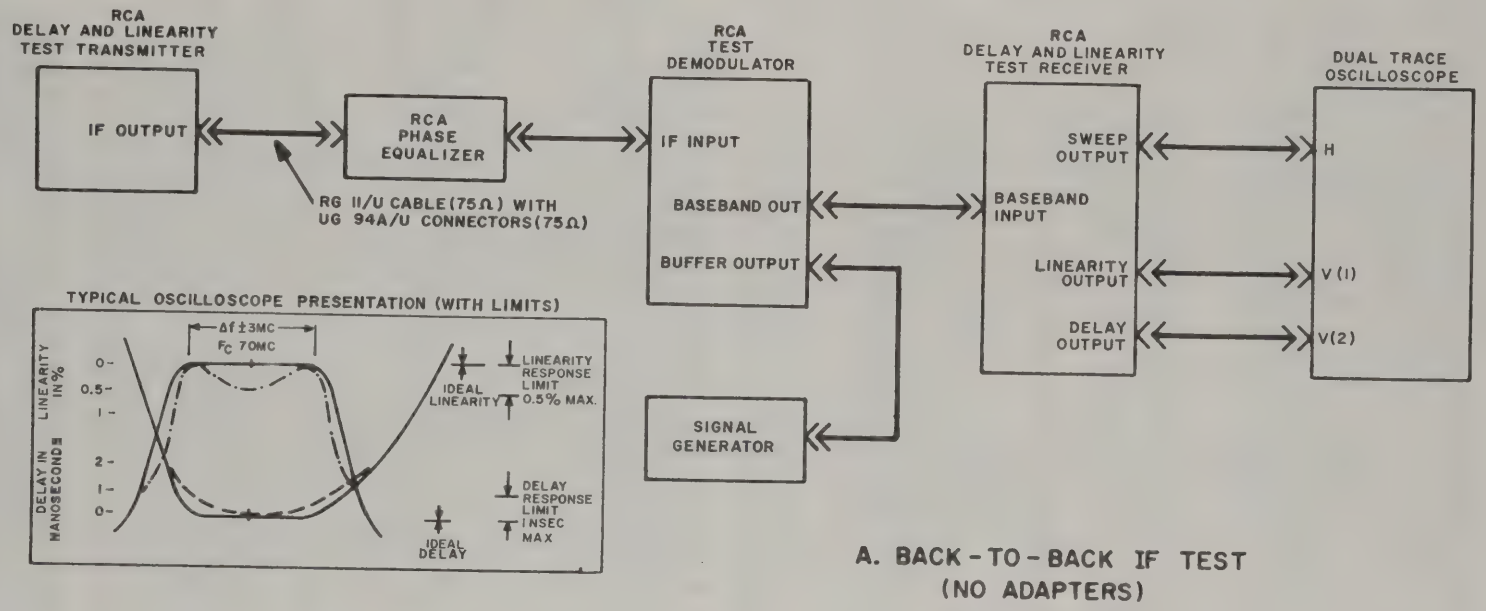
(a) Connect the equipment as shown in Figure 4-16.

(b) Calibrate the vertical deflection of the linearity trace by depressing the LINEARITY CALIBRATE 2% switch and observing the separation between the two linearity traces of 2%. Adjust the Oscilloscope vertical gain control for four boxes so that each box represents 0.5%.

(c) Calibrate the vertical deflection of the delay trace by depressing the DELAY CALIBRATE -10 mμsec switch and observing the separation between the two delay traces of 10 nanoseconds. Adjust the Oscilloscope vertical gain for five boxes, so that each box represents 2 nanoseconds.

(d) Calibrate the delay and linearity trace bandwidth (horizontal sensitivity on Oscilloscope) by connecting a VHF Signal Generator to the BUFFER OUTPUT jack on the RCA Demodulator and adjusting the IF DEV 500 CPS control on the Delay and Linearity Transmitter for the proper bandwidth according to the channel capacity of the equipment under test: 72 channels ±1.0 mc or 120/132 channels ±1.5 mc, or 240/252 channels ±2.5 mc.

(e) The IF DEV 200 KC control on the Delay and Linearity Transmitter can be adjusted for minimum noise on the Oscilloscope; however, the delay and linearity traces should be recalibrated each time this is done.

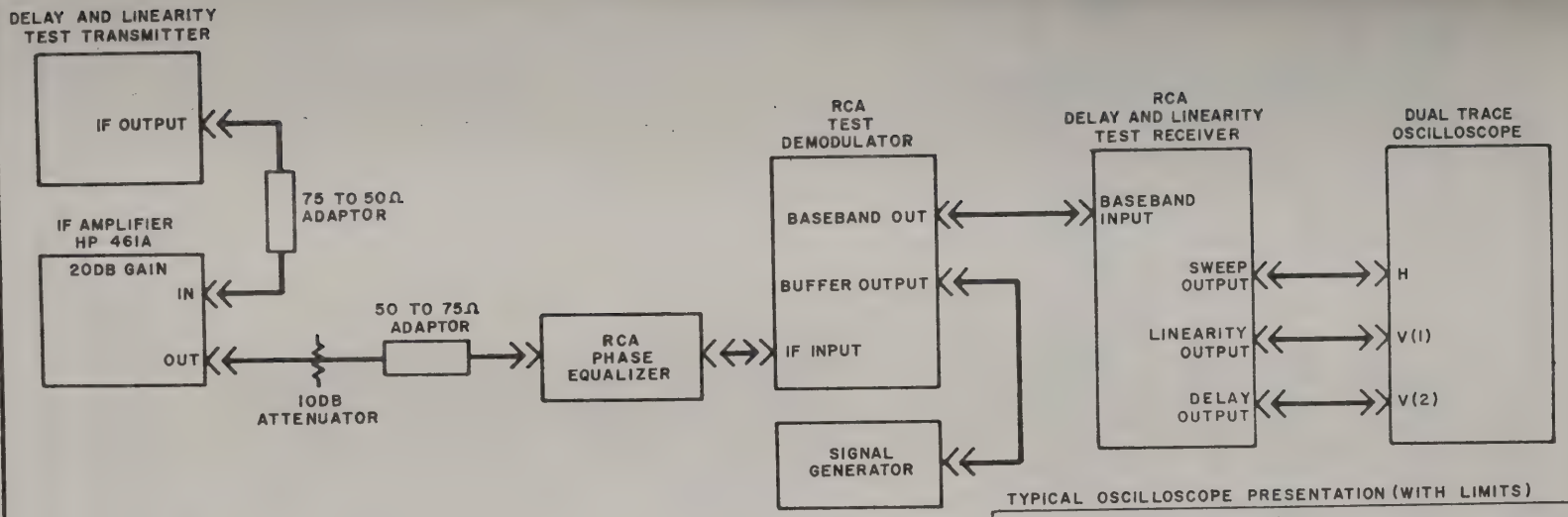


A. BACK-TO-BACK IF TEST
(NO ADAPTERS)

NOTE: (Continued on Sheet 2 of 2)

a) Calibrate the vertical deflection of the linearity trace by pressing the LINEARITY CALIBRATE 2% switch and adjusting the vertical (1) gain control on the oscilloscope for 4 boxes between traces, so that each box represents 0.5% non-linearity.

b) Calibrate the vertical deflection of the delay trace by pressing the DELAY CALIBRATE - 10 mμsec (nanoseconds) switch and adjusting the vertical (2) gain control on the oscilloscope for 5 boxes between traces, so that each box represents 2 nanoseconds delay.



B. BACK – TO – BACK IF TEST
(WITH ADAPTERS)

NOTE: (Continued from Sheet 1 of 2)

c) Calibrate the horizontal deflection of the delay and linearity bandwidth trace by adjusting the IF DEV 500 CPS baseband level control for the required bandwidth (70 mc ±3 mc) as established by the use of the marker signal generator. Adjust the horizontal gain control on the oscilloscope for a convenient reference (±4 boxes) on the oscilloscope screen.

d) The IF DEV 200 KC potentiometer may be adjusted for minimum noise on the oscilloscope, however, the delay and linearity horizontal and vertical traces on the oscilloscope should be recalibrated each time the IF DEV 200 KC potentiometer is used.

Figure 4-18. IF Back-to-Back Delay and Linearity Calibration (Sheet 2 of 2)

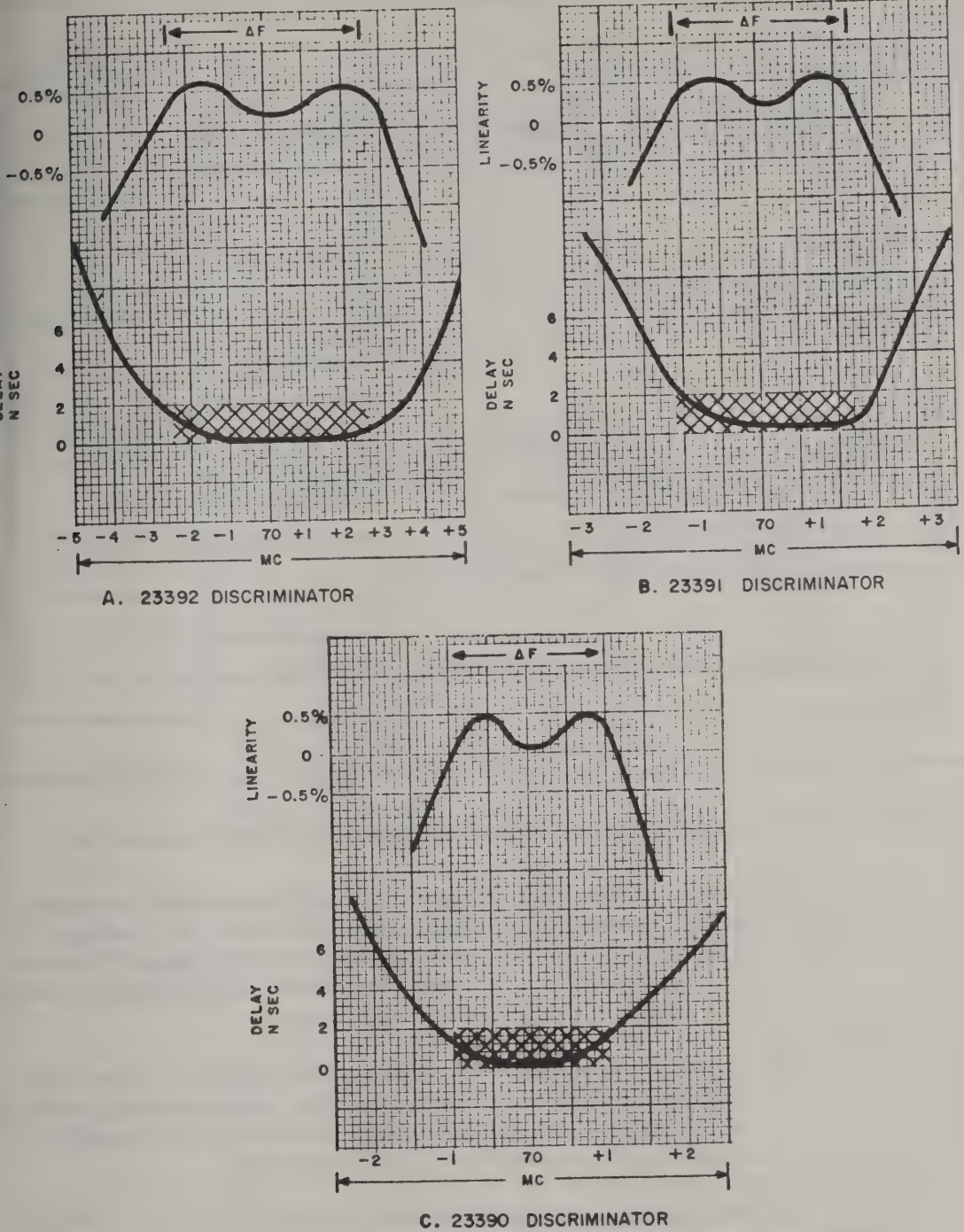
(f) Check the delay and linearity of the combination of the Compress Limiter and Driver-Discriminator.

(g) Requirements: Symmetrical delay of 2 nanoseconds maximum and nonlinearity of 0.5 percent maximum over the specified bandwidth in step (d). Refer to Figure 4-19 for reference.

(h) If the delay and linearity requirements are not met, refer to paragraph F-3 for troubleshooting.

(i) Connect the equipment as shown in Figure 4-20.

(j) Check the delay and linearity of the combination of IF Amplifier (2 Compressor Limiter and Driver-Discriminator by connecting the IF output of the Delay and Linearity Test Transmitter via the Matching Adapter and the 10-db Attenuator (AT1) to IF input jack J1 on IF Amplifier (2).



NOTE: Cross hatched area represents the limits of allowable Compressor Limiter and Discriminator Group Delay

Figure 4-19. Compressor Limiter-Discriminator Typical Delay and Linearity

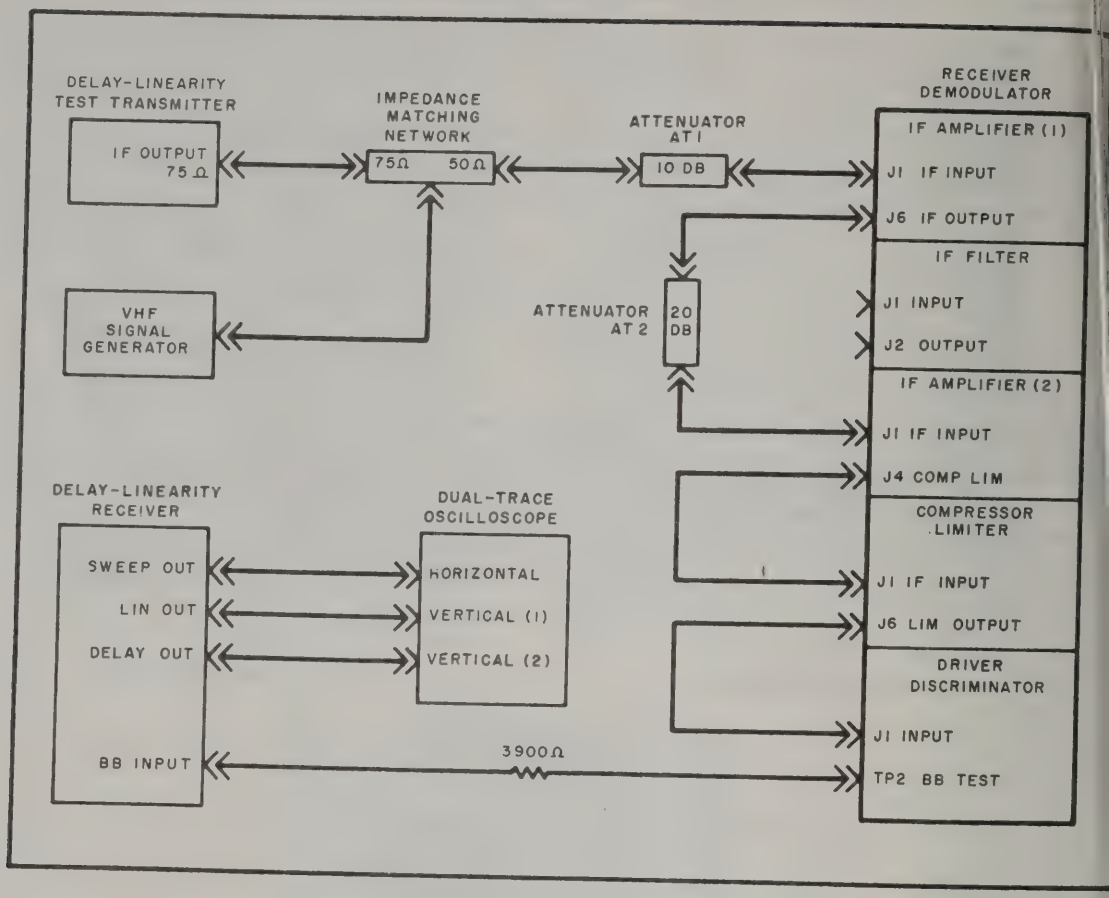


Figure 4-20. IF Amplifier Section Group Delay and Linearity Response Test

(k) Requirements: Symmetrical delay of 3 nanoseconds maximum and nonlinearity of 0.5 percent maximum over the specified bandwidth in step (d). Consequently the IF Amplifier (2) should not add more than 1 nanosecond delay to the combination of step (g). Refer to Figure 4-19 for reference.

(l) If the delay and linearity requirements of step (k) are not met, while the Compressor Limiter and Discriminator were previously tested in step f and g, and found to be satisfactory, retune IF Amplifier (2) as described in paragraph F-4c.

(m) Connect the equipment as shown in Figure 4-20.

(n) Check the delay and linearity of the combination of IF Amplifier (1), IF Amplifier (2), Compressor Limiter and Driver-Discriminator by connecting the IF output of the Delay and Linearity Test Transmitter through the Matching Adaptor, 10-db Attenuator (AT1), IF Amplifier (1), 20-db Attenuator (AT2) to IF Input jack J1 on IF Amplifier (2).

(o) Requirements: Symmetrical delay of 4 nanosecond maximum and nonlinearity of 0.5 percent maximum over the specified bandwidth in step (d). Consequently IF Amplifier (1) should not add more than 1 nanosecond delay to the combination of step (k). Refer to Figure 4-19 for reference.

(p) If the delay and linearity requirements of step (o) are not met, while the requirements of step (k) are satisfied, retune IF Amplifier (1) as described in paragraph F-4b.

(q) Remove the 20-db Attenuator (AT2) between IF Amplifier (1) and IF Amplifier (2) and insert the Linear Phase Filter (PF 1394 or PF 1425).

(r) Check the delay and linearity of the entire IF Amplifier section.

(s) Requirements: Symmetrical delay of 4 nanoseconds maximum and nonlinearity of 0.5 percent maximum over the specified bandwidth in step (d). Consequently the Linear Phase Filter should be so equalized as to be transparent to the total combination of step (o). Refer to Figure 4-21 for reference.

(t) If the delay and linearity requirements of step (s) are not met, while the requirements of step (o) are satisfied, check and if necessary retune the Linear Phase Filter as described in paragraph F-4d.

(u) Remove all test equipment and restore equipment to normal operation.

b. IF Amplifier (1) Alignment

The purpose of this procedure is to check and if necessary, align IF Amplifier (1) when the delay and linearity requirements of paragraph F-3, or the IF Bandwidth specifications of the Demodulator cannot be met or when the module has been repaired or replaced. An Oscilloscope, VHF Signal Generator, Test Oscillator, VHF Sweep Generator, VSWR Detector, Step Attenuator, High-Impedance Detector Probe, AGC Bias Box, Delay and Linearity Test Set, Impedance Matching Network, DC VTVM, RF Voltmeter, Frequency Counter, 3900-ohm Resistor, 100 microfarad

capacitor, and 50-ohm Termination are required for this procedure. In addition, a Printed Circuit Card Cheater Assembly (part of Adapter Kit) is required to extend t module above the level of the drawer for testing and adjusting.

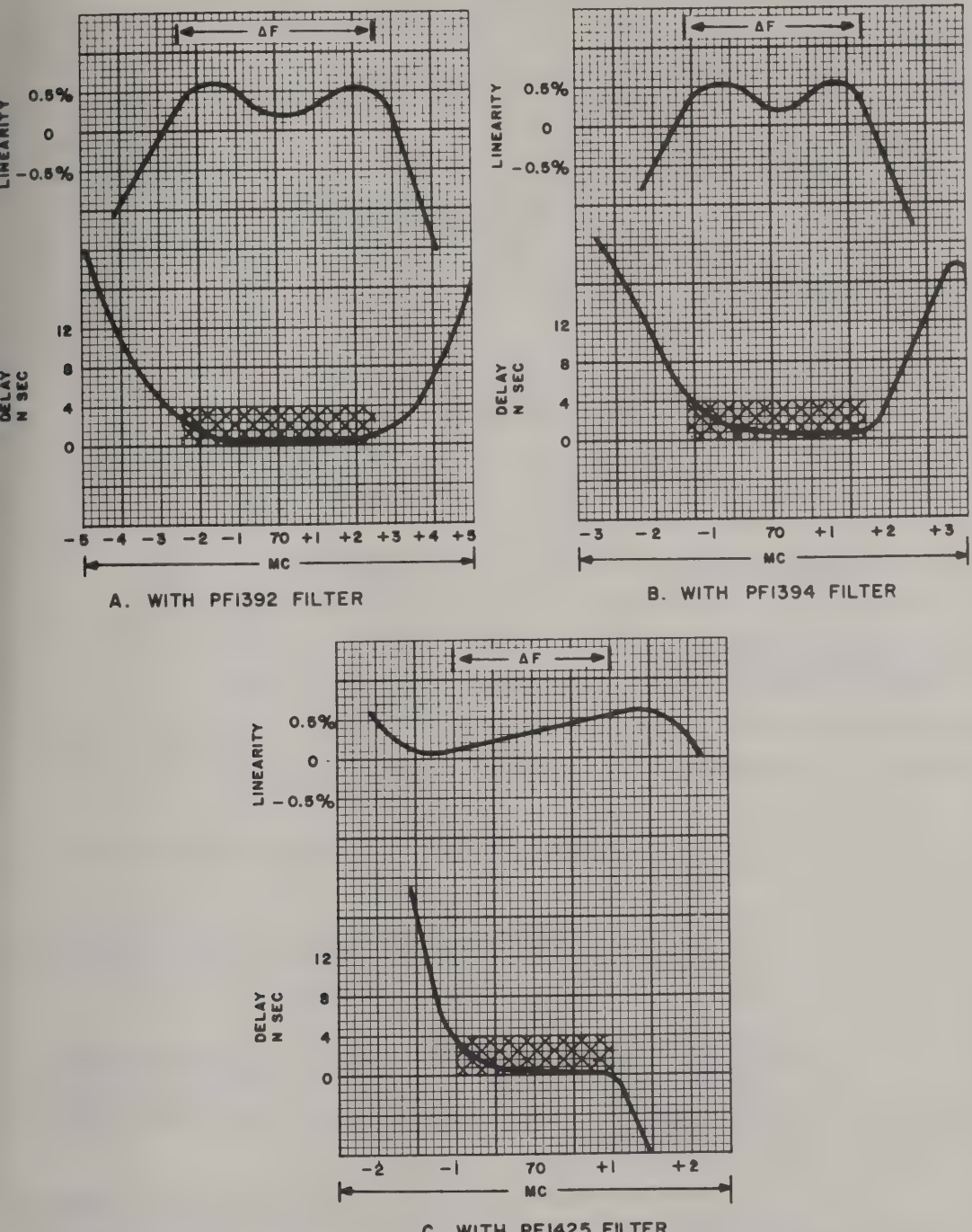
NOTE: When making any adjustments on IF Amplifier (1) to meet the specific limits, recheck all preceding steps that may be affected by such an adjustment.

(1) VSWR Test and Alignment

(a) Using the Printed Circuit Card Cheater Assembly, connect the IF Amplifier (1) into the drawer.

(b) Connect the test equipment as shown in figure 4-22

(c) Using the Frequency Counter, set the VHF Signal Generator for the 70-mc marker (1).



NOTE: Cross hatched area represents the limits of allowable group delay of the IF Amplifier Section (with Filter)

Figure 4-21. IF Amplifier Section Typical Group Delay and Linearity

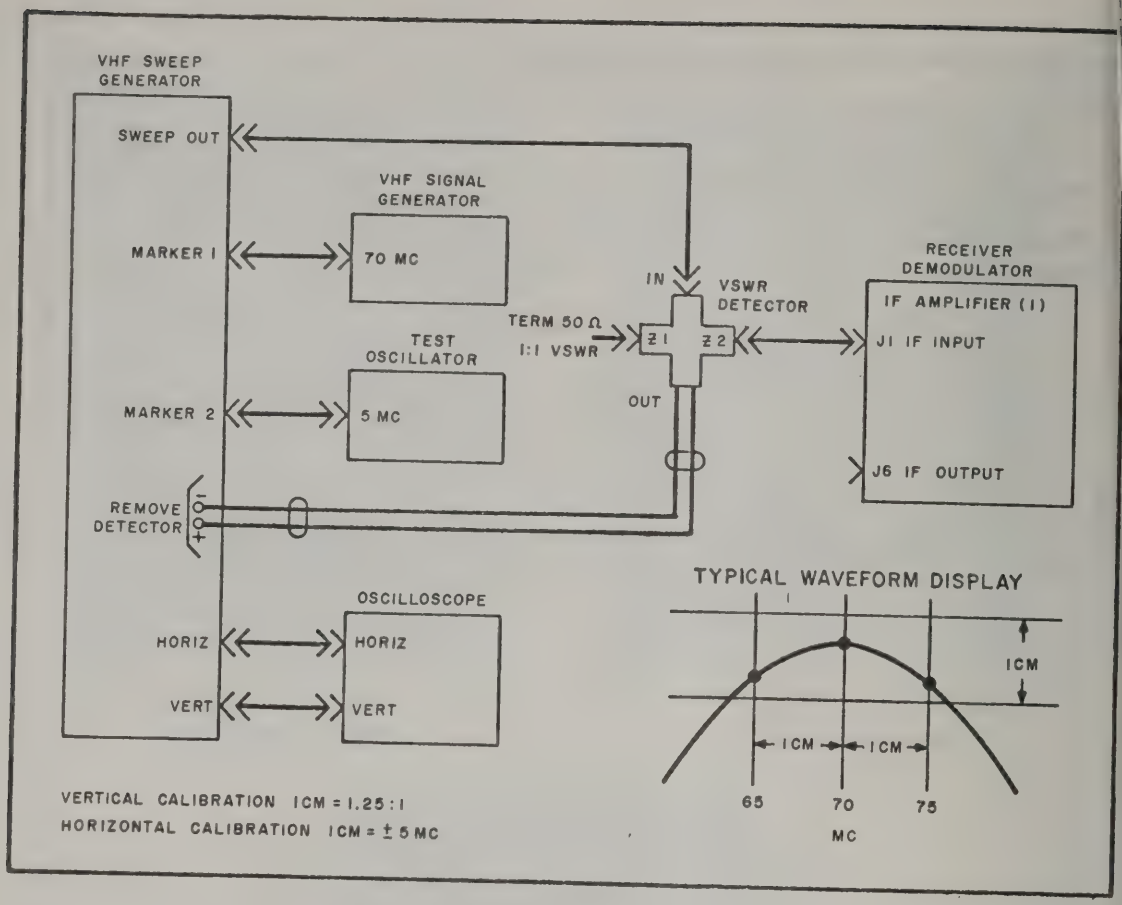


Figure 4-22. IF Amplifier (1) VSWR Test

(d) Using the Frequency Counter, set the Test Oscillator for the 5-mc marker (2).

(e) Calibrate the horizontal deflection on the Oscilloscope by adjusting the Frequency Knob on the Sweep Generator until the 70-mc marker is centered on the horizontal axis.

(f) Adjust the Width Control and Frequency Controls on the Sweep Generator so that the ±5 MC side markers are 1 cm on either side of the 70 MC center marker. Do not touch these controls from this point on.

(g) Calibrate the vertical deflection on the Oscilloscope by connecting a 1.25:1 VSWR Standard to Z2 on the VSWR Detector and adjust the Vertical Sensitivity Controls on the Oscilloscope to obtain a 1 cm display.

(h) Remove the 1.25:1 VSWR Standard from Z2 and connect Z2 to IF INPUT connector J1 on IF Amplifier (1).

(i) Observe that the VSWR is no more than 1.25:1 centered on the ±5 MC markers.

(j) If requirement of step a(i) is met, proceed to step a(l); otherwise proceed to step (k).

(k) Adjust capacitors C1, C2, C5, transformer slug T1 and potentiometer R1 for a VSWR of 1.25:1 maximum centered on the ±5 MC markers.

(l) Disconnect Z2 of the VSWR detector from IF Input connector J1 and connect Z2 of the VSWR Detector to IF OUTPUT connector J6.

(m) Observe that the VSWR is no more than 1.25:1 centered on the ±5 MC markers.

(n) If requirement of step (m) is met proceed to step (p); otherwise proceed to step (o).

(o) Adjust capacitors C24, C27, C39, transformer slug T6, and potentiometer R34 for a VSWR of 1.25:1 maximum centered on the ±5 MC markers.

(p) Remove the VSWR standard from Z2 and connect Z2 to connector J3 on IF Amplifier (1).

(q) Observe that the VSWR is no more than 1.25:1 centered on the ±5 MC markers.

(r) Disconnect the test equipment.

(2) Gain and Bandwidth Test Alignment

(a) Connect the test equipment as shown in figure 4-23.

(b) Remove Shorting Cap P4 from connector J7 and connect a 100 microfarad capacitor between the base and collector of AGC Amplifier Q7.

(c) Connect the High Impedance Detector Probe between the base resistor R9 of transistor Q2 and ground.

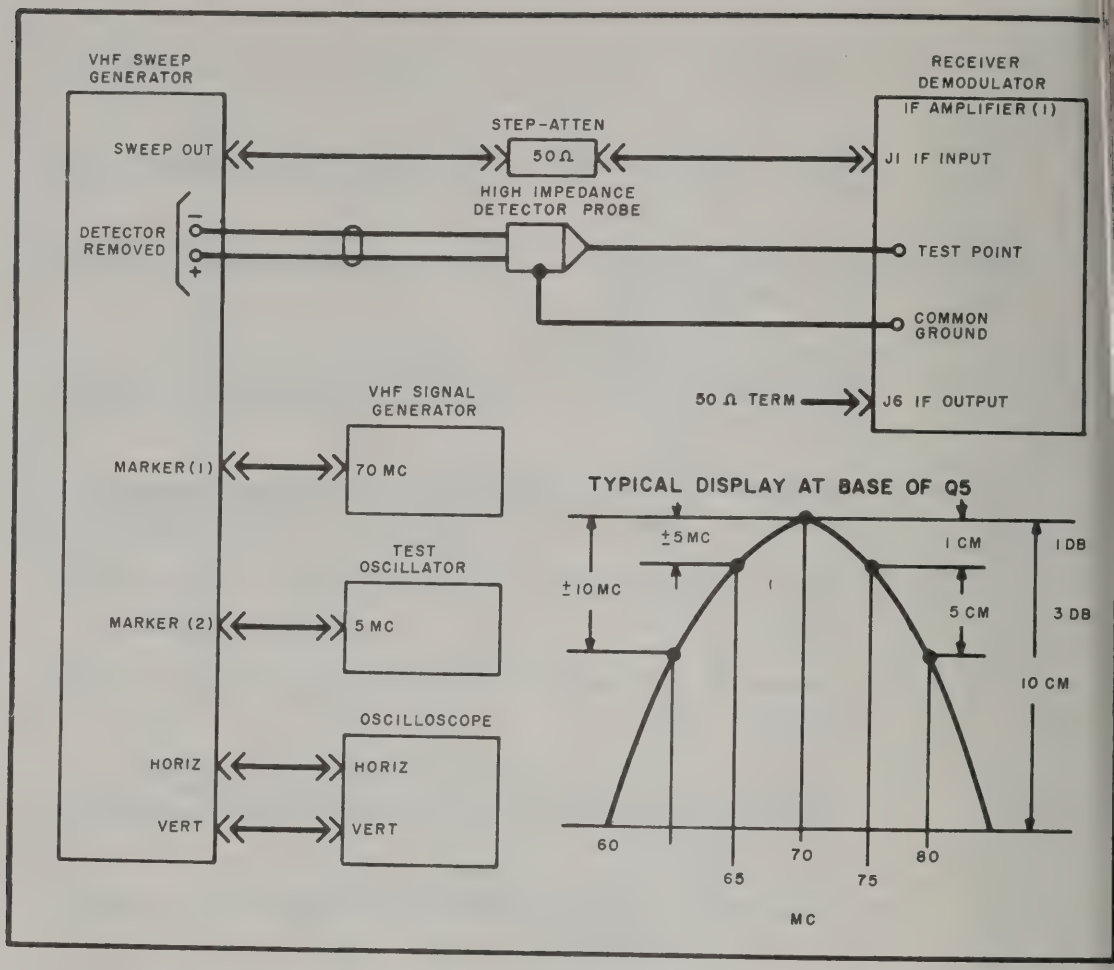


Figure 4-23. IF Amplifier (1) Gain and Bandwidth Alignment

(d) Adjust the AGC output of the Sweep Generator in conjunction with the Step-Attenuator (approximately 20 db) to produce a vertical deflection of 10 cm on the Oscilloscope with the Vertical Sensitivity switch of the Oscilloscope set to the 5 mv position.

(e) Using 3 db attenuation of the Step-Attenuator, calibrate the Oscilloscope for a 3-db deflection; then, restore to condition of step (d).

(f) Disconnect the High Impedance Detector Probe from Q2.

(g) Using the Frequency Counter, set the VHF Signal Generator for the 70 mc marker (1).

(h) Using the Frequency Counter, set the Test Oscillator for the 5 mc marker (2).

(i) Adjust the amplitude of the markers to obtain three markers on the Oscilloscope (70 mc ±5 mc).

(j) Set the Sweep Generator width control and the horizontal deflection on the Oscilloscope to obtain the three markers spaced 1 cm apart.

(k) Increase the amplitude of the 5-mc markers until two additional markers appear with the same spacing. The Oscilloscope should now show five markers spaced 1 cm apart at 60, 65, 70, 75 and 80 mc (see figure 4-23).

NOTE: The side markers are derived from the 5-mc marker mixing with the 70-mc marker; which in turn, mixes with the Sweep Generator's output.

(l) Do not touch any of the controls on the test equipment from hereon.

(m) Connect the High-Impedance Detector Probe between the base of Amplifier Q2 and resistor R9.

1. Observe that a symmetrical bandwidth centered on the markers is obtained on the Oscilloscope Screen.

2. If necessary, roughly peak tune trimmers C5, C7 and transformer slug T2 for a symmetrical bandwidth centered on the markers.

3. Using the Step Attenuator, reduce the output level of the Sweep Generator when the vertical deflection of the Sweep Generator when the vertical deflection of the Oscilloscope exceeds 10 cm.

4. Recheck the 3 db calibration on the oscilloscope.

NOTE: There will normally be interaction between the trimmer and the transformer adjustments as well as interaction from the succeeding stages. This is a normal condition.

(n) Connect the High-Impedance Detector Probe between the base resistor R19 of Amplifier Q3 and ground.

1. Observe that a symmetrical bandwidth centered on the markers is obtained on the Oscilloscope Screen.

2. If necessary, roughly peak tune trimmers C12, C13 and transformer slug T3 to obtain a symmetrical bandpass centered on the markers.

3. If necessary, repeak trimmers C12 and C7 and transformer slug T2 to meet the requirements of step 1.

4. Using the step attenuator, reduce the output level of the Swee Generator when the vertical deflection on the Oscilloscope exceeds 10 cm.

5. Recheck the 3 db calibration on the Oscilloscope.

(o) Connect the High-Impedance Detector Probe between the base resistor R25 of Amplifier Q4 and ground.

1. Observe that a symmetrical bandwidth centered on the markers is obtained on the Oscilloscope Screen.

2. If necessary, roughly peak tune trimmers C17, C19 and transforming slug T4.

3. If necessary, repeak trimmers and transformer slugs of the previous stages to obtain a symmetrical bandpass centered on the markers.

4. Using the Step-Attenuator, reduce the output level of the Sweep Generator when the vertical deflection on the Oscilloscope exceeds 10 cm.

5. Recheck the 3 db calibration on the Oscilloscope.

(p) Connect the High-Impedance Detector Probe between the base resistor R31 of Amplifier Q5 and ground.

1. Use the Step-Attenuator to reduce the output level of the Sweep Generator when the vertical deflection on the Oscilloscope exceeds 10 cm.

2. Recheck the 3 db calibration on the Oscilloscope.

3. Observe that a symmetrical bandwidth centered on the markers is obtained on the Oscilloscope Screen.

4. If necessary, roughly peak tune trimmers C22, C24 and transformer slug T5 for a symmetrical bandpass centered on the markers.

5. If necessary, slightly repeak trimmers C19 and C17 and transformer slug T4 to meet the requirements of step 1.

(q) Disconnect the Detector Probe from Q5.

(r) Recheck the input VSWR (refer to figure 4-22).

NOTE: Due to interaction of bandpass alignment and adjustments, the base impedance of first Amplifier Q1 may have changed.

1. If necessary, realign the input VSWR by adjusting trimmers C1, C2 and; if necessary, C5, transformer slug T1 and potentiometer R1.

2. Center the VSWR on the 70-mc marker with the edges of the Oscilloscope pattern falling symmetrically on the first set of the ±5-mc side markers; which in turn, is within the corresponding 1.25:1 VSWR vertical Oscilloscope calibration of 1 cm.

(s) Recheck the output VSWR (refer to figure 4-22).

NOTE: Due to interaction of bandpass alignment and adjustments the output impedance of Amplifier Q5 may have changed and therefore the output VSWR may have to be realigned.

1. If necessary, realign the output VSWR by adjusting trimmers C39, C27 and; if necessary, C24, potentiometer R34 and transformer slug T6.

2. Center the VSWR 70-mc marker with edge of the Oscilloscope pattern falling symmetrically on the first set of ±5-mc side markers; which in turn, is within the corresponding 1.25:1 VSWR vertical Oscilloscope calibration of 1 cm.

3. Remove the VSWR Detector from J6.

(t) Connect the VHF Signal Generator tuned to 70 MC, to IF INPUT connector J1.

(u) Using a 50-ohm Adapter, connect the RF Voltmeter to IF OUTPUT connector J6.

(v) Adjust the output level of the Signal Generator to produce an indication on the RF Voltmeter of 100 mv, corresponding to -7 dbm. The difference in the Signal Generator level in dbm and the indication on the RF Voltmeter represents the gain of IF Amplifier (1).

EXAMPLE: Signal Generator output dial reading = -47 dbm
RF Voltmeter indication = -7 dbm
IF Amplifier (1) Gain = 40 db

NOTE: Depending on the care taken in the alignment up to this point, the gain may vary from 33 to 42 db.

(w) Connect the test equipment as shown in figure 4-24.

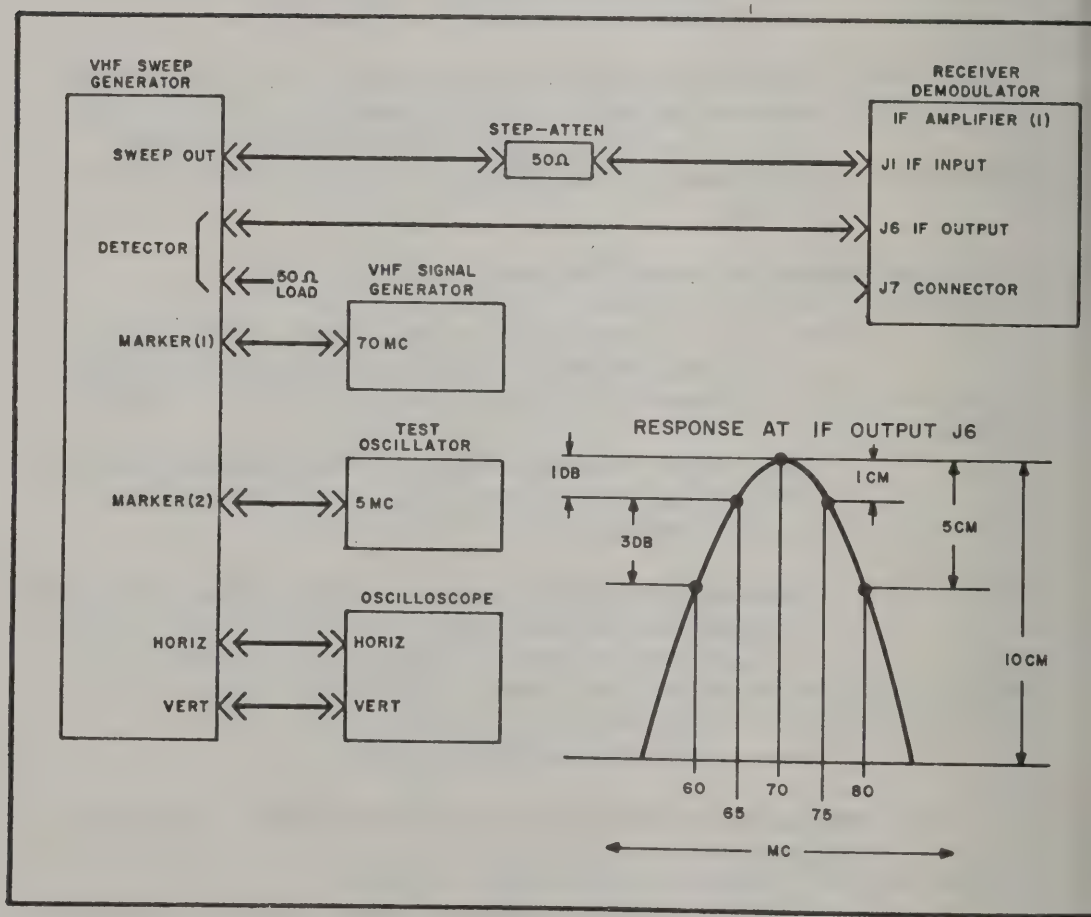


Figure 4-24. IF Amplifier (1) Overall Bandwidth Alignment

(x) Using the Step-Attenuator and the AGC level control on the Sweep Generator, recalibrate the vertical deflection on the Oscilloscope for a display of 10 dm attenuation. Center the bandpass pattern on the Oscilloscope.

(y) Insert an additional 4 db attenuation in the Step-Attenuator to establish a deflection calibration on the Oscilloscope for a 4 db difference in gain or level; then restore condition of step (x).

(z) If the gain of IF Amplifier (1), measured in step (v) was 33 db, proceed as follows:

1. Insert an additional 5 db attenuation to further reduce the vertical deflection on the Oscilloscope.

2. Carefully repeak transformer slug T5, trimmers C22 and C19 to obtain a full scale Oscilloscope deflection of 10 cm.

NOTE: When adjusting the above controls, always center the bandpass on the markers to obtain a symmetrical bandpass.

3. The above adjustments should increase the IF Amplifier gain by about 5 db.

(aa) If the gain of IF Amplifier (1), measured in step (v), was 36 to 42 db, proceed as follows:

1. Do not insert any additional attenuation, as in step (z), to increase the gain.

2. If necessary, readjust transformer slug T5, trimmers C22 and C19 for a symmetrical bandpass, centered on the markers.

(ab) When the requirements for gain and bandwidth have been met, calibrate the Oscilloscope for a 1 db and 3 db vertical reduction in scope deflection.

1. The first set of ±5 mc side markers should fall symmetrically within the 1-db calibration of the IF Amplifier's bandpass.

2. The second set of ±5 MC side markers (±10 mc from center frequency) should fall symmetrically within the 3-db calibration of the IF Amplifier's bandpass.

3. If the requirements in steps 1 and 2 are met, proceed to step (af).

4. If the requirements in steps 1 and 2 are not met, carefully readjust transformer slug T5, trimmers C22 and C19 until the markers do fall symmetrically on the markers at the 1-db and 3-db calibration points. Recheck the gain, steps (t through (v), which can vary from 37 to 42 db.

(ac) Check the overall IF Amplifier (1) bandwidth as follows:

1. Connect the VHF Signal Generator tuned to 70 MC to IF INPUT connector J1.

2. Using a 50-ohm Adapter, connect the RF Voltmeter to IF OUTPUT connector J6.

3. Using the Frequency Counter, check that the Signal Generator is set for 70 mc and the level for 100 mv or -7 dbm (50Ω).

4. Decrease the output level of the Signal Generator in 1, 3, and 10-db steps and check that the RF Voltmeter indicates the same amount of decrease in level through the IF Amplifier

NOTE: This assures that the IF Amplifier is operating in the linear gain region.

(ad) Check the 1-db bandwidth as follows:

1. Increase the frequency of the Signal Generator above 70 mc until the RF Voltmeter indicates a decrease of 1 db. Measure the Signal Generator frequency with the Frequency Counter.

2. Decrease the frequency of the Signal Generator below 70 MC until the RF Voltmeter indicates a decrease of 1 db and measure the Signal Generator frequency with the Frequency Counter.

3. Calculate the 1-db bandwidth by subtracting the frequency recorded in step 2 from the frequency recorded in step 1. It should be 10 mc minimum.

(ae) Check the 3 and 10-db bandwidths in a like manner. The 3-db bandwidth should be from 18 to 24 mc and the 10-db bandwidth should be from 28 to 40 mc.

(af) When all requirements have been met, disconnect the 100 microfarad capacitor across the base and collector of Amplifier Q7 and reconnect the shorting cap P4 to connector J7.

(3) AGC Gain Reduction Test

(a) Connect the VHF Signal Generator tuned to 70 MC to IF INPUT connector J1.

(b) Connect the RF Voltmeter to IF OUTPUT connector J6.

(c) Using the Frequency Counter, set the Signal Generator for 70 MC.

(d) Starting with the output level of the Signal Generator set at 0.1 mv (-67 dbm) slowly increase the output level to 500 mv (+7 dbm). The reading on the RF Voltmeter should indicate saturation at J6 between 250 and 350 mv.

(e) If the RF Voltmeter indicates a saturation above 350 mv at J6, proceed as follows:

1. Adjust capacitor C39 slightly until the indication is approximately 350 mv.

2. Recheck the output VSWR at J6 (refer to figure 4-22).

3. If the VSWR is not 1.25:1 or better, readjust capacitors C22, C24, C27, transformer slugs T5 and T6, and potentiometer R34 until the requirement is met. Do not adjust capacitor C39 again.

(4) AGC Tests

(a) Remove shorting cap P4 from connector J7 and connect the AGC Box (refer to figure 4-25) between outside of jack J7 and ground.

(b) Set up the equipment as shown in figure 4-24.

(c) Slowly adjust the AGC potentiometer (part of AGC Bias Box) counterclockwise.

(d) The response curve as displayed in the Oscilloscope should decrease symmetrically in amplitude as the AGC voltage increases to +1.5 volts dc. Refer to part A of figure 4-26.

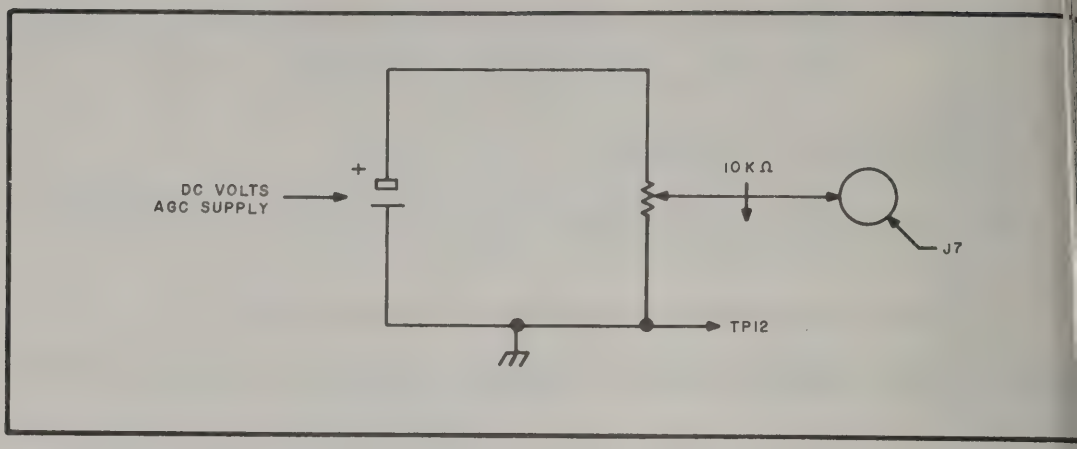


Figure 4-25. AGC Bias Box

(e) Note the position of the 70 MC marker as the AGC voltage is increased. If the response curve is distorted, and the 70 MC marker shifts (part B of figure 4-26), it will be necessary to check the transistors and if necessary retune the IF Amplifier.

(f) Connect the VHF Signal Generator tuned to 70 MC to IF INPUT connector J1 and the RF Voltmeter to IF OUTPUT connector J6.

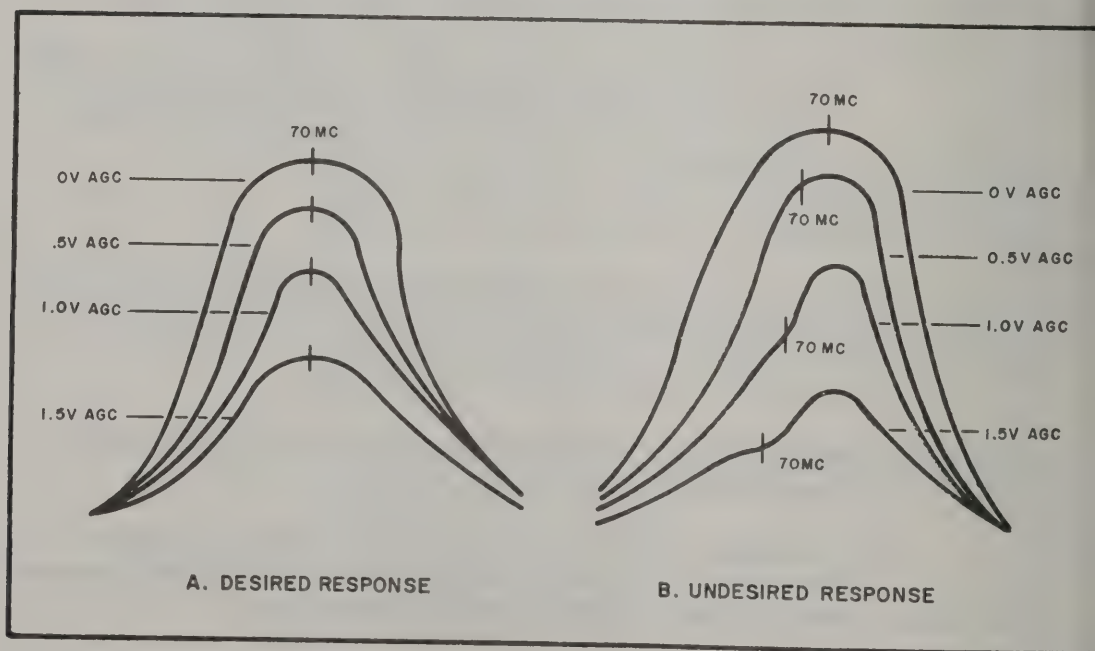


Figure 4-26. IF Amplifier (1) Bias Versus Amplitude Response Curves

(g) Remove the AGC bias box and connect the shorting cap P4 to connector J7.

(h) Check the AGC gain reduction by setting the output level of the Signal Generator at 10, 50, 200, and 500 mv respectively. The RF Voltmeter should indicate between 250 and 350 mv for each input level.

(i) When the delay and linearity requirements of IF Amplifier (1) are met, remove the IF Amplifier (1) from the cheater assembly and restore the cards and cables for normal operation. Recheck delay and linearity with the card inside the drawer.

c. IF Amplifier (2) Alignment

The purpose of this procedure is to check and if necessary, align IF mplifier (2) when the delay and linearity requirements of paragraph F-3 or the IF ndwidth specifications of the Demodulator cannot be met or when the module has en repaired or replaced. An Oscilloscope, VHF Sweep Generator, VHF Signal nerator, Test Oscillator, a VSWR Detector, Step Attenuator, DC VTVM, RF ltmeter and 50-ohm Termination are required for this procedure. In addition, a inted Circuit Card Cheater Assembly (Part of Adapter Kit) is required to extend e module above the level of the drawer for testing and adjusting.

NOTE: When making any adjustments on IF Amplifier (2) to meet the specified limits, recheck all preceding steps that may be effected by such an adjustment.

(1) VSWR Test and Alignment

(a) Using the Printed Circuit Card Cheater Assembly, connect the IF Amplifier (2) into the drawer).

(b) Connect the test equipment as shown in figure 4-27.

(c) Using the Frequency Counter, set the frequency of the VHF Signal Generator to 70 mc.

(d) Using the Frequency Counter, set the frequency of the Test Oscillator to 5 mc.

(e) Calibrate the horizontal deflection of the Oscilloscope by adjusting the Sweep Generator frequency knob until the 70-mc marker is centered on the Scope's horizontal axis.

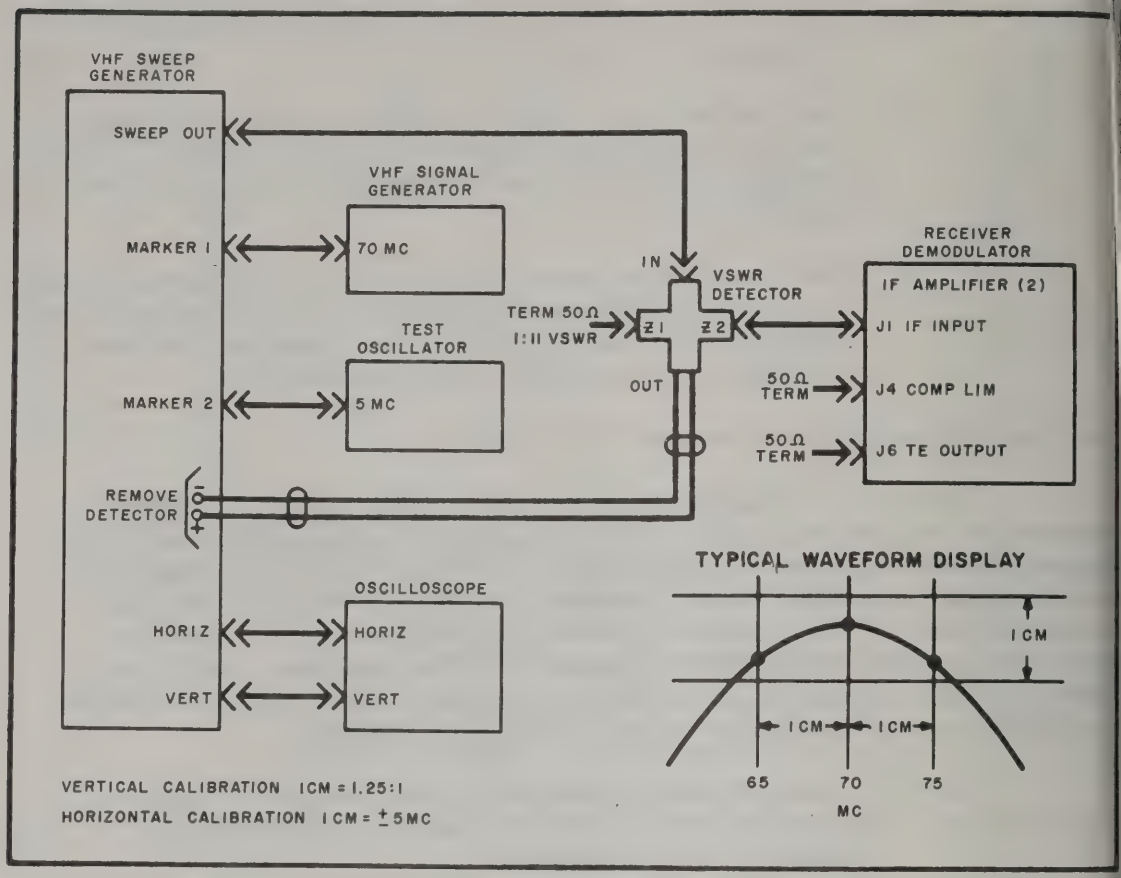


Figure 4-27. IF Amplifier (2) VSWR Alignment

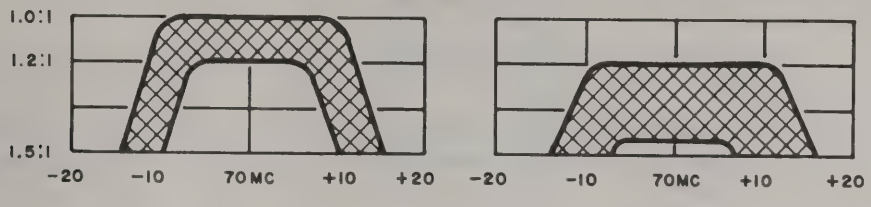
(f) Adjust the width control and frequency controls on the Sweep Generator so that the ±5-mc markers are 1 cm displaced on either side of the 70-mc center marker. DO NOT adjust these controls from this point on.

(g) Calibrate the vertical deflection on the Oscilloscope by connecting a 1.25:1 VSWR standard to Z2 of the VSWR Detector and adjusting the vertical sensitivity controls on the Oscilloscope to obtain a 1 cm display.

(h) Disconnect the 1.25:1 VSWR standard from Z2 of the VSWR Detector.

(i) Connect Z2 of the VSWR Detector to IF Amplifier (2) input jack J1.

(j) Observe that the VSWR is no more than 1.25:1 centered on the ±5-mc markers. Refer to figure 4-28, part A.



A. VSWR AT J1

B. VSWR AT J4 AND J6

Figure 4-28. IF Amplifier (2) VSWR Response Curves

(k) If requirement of step (j) is met, proceed to step (m); otherwise proceed to step (l).

(l) If necessary adjust capacitors C1, C3 potentiometer R1 and transformer slug T1 for an input VSWR of 1.25:1 maximum centered on the ±5-mc markers.

(m) Disconnect Z2 of the VSWR detector from IF INPUT connector J1. Calibrate the vertical deflection on the Oscilloscope by connecting a 1.5:1 VSWR standard to Z2 on the VSWR Detector and adjusting the vertical sensitivity control on the Oscilloscope to obtain a 1-cm display.

(n) Remove the VSWR standard from Z2 and connect Z2 to COMP LIM connector J4 on IF Amplifier (2).

(o) Observe that the VSWR is no more than 1.5:1 centered on the ±5-mc markers. Refer to figure 4-28, part B.

(p) If necessary, adjust capacitors C10, C15 and transformer slug T3 for an output VSWR of 1.5:1 maximum centered on the ±5-mc markers.

(q) If threshold extension is used, disconnect Z2 of the VSWR detector from connector J4 and connect it to TE connector J6.

(r) Observe that the VSWR is no more than 1.5:1 centered on the ±5 MC markers. Refer to figure 4-28, part B.

(s) If necessary, adjust capacitors C19, C23 and transformer slug T4 for an output VSWR of 1.5:1 maximum centered on the ±5-mc markers.

(2) Bandwidth Test and Alignment

(a) Connect the test equipment as shown in figure 4-29.

(b) Observe that a symmetrical bandwidth response within the specifications of figure 4-30 is obtained on the Oscilloscope Screen.

(c) If the requirement of step (b) is not met, adjust capacitors C4 and C9 and transformer slug T2 for the best response within limits of figure 4-30.

(d) If the response requirements of figure 4-30 are still not met, slightly readjust capacitors C10 and C15 and recheck the output VSWR.

(e) Determine the bandwidth between connector J1 and J4 from the indication on the Oscilloscope. It should be a symmetrical response between 22 to 33 mc at the -3 db points.

(f) Determine the gain between connector J1 and J4 from the Oscilloscope display. It should be 20 db ±3 db.

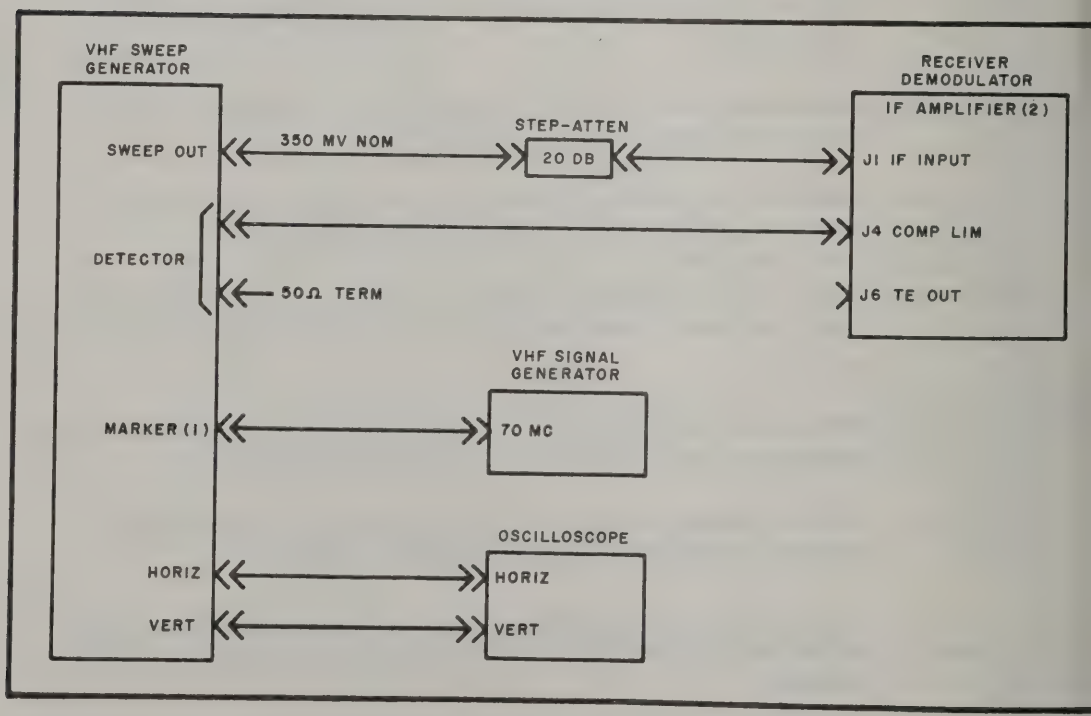


Figure 4-29. IF Amplifier (2) Bandwidth Test and Alignment

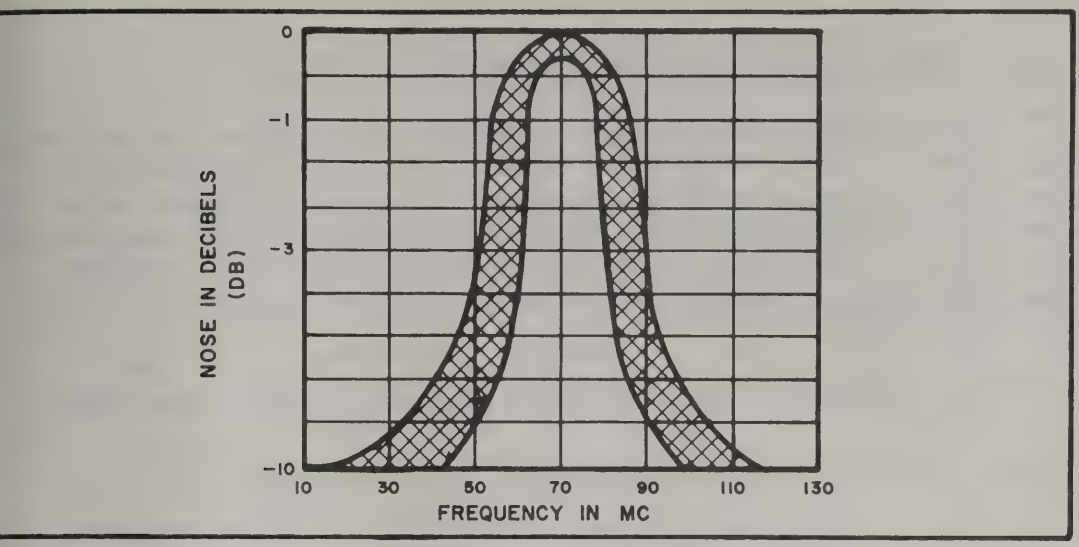


Figure 4-30. IF Amplifier (2) Response Curve

(g) Using the above procedure determine the bandwidth between connectors J4 and J6. It should be a symmetrical 22 to 33 mc at the -3 db points.

(h) Determine the gain between connector J1 and J6 from the Oscilloscope display. It should be 20 db ±3 db.

(i) Connect the VHF Signal Generator tuned to 70 mc to IF INPUT connector J1.

(j) Connect the RF Voltmeter to COMP LIM connector J4 and check the limiting.

(k) Set the output level of the Signal Generator to 200 mv and then to 500 mv. The output limits should be from 800 to 1000 mv on the RF Voltmeter.

(l) Connect the RF Voltmeter to TE connector J6 and check the limiting as in step (j). The output limits should be from 800 to 1000 mv on the RF Voltmeter.

(m) When all requirements have been met, disconnect all test equipment and check the delay and linearity response of IF Amplifier (2) as described in paragraph F-3.

(n) When the delay and linearity requirements of IF Amplifier (2) are met, remove the IF Amplifier from the Cheater Assembly and restore the card and cables to normal condition. Recheck the delay and linearity requirements with the card inside the drawer.

d. Linear Phase IF Filter Test and Alignment

The purpose of this procedure is to check and if necessary align the Linear Phase IF Filter (PF1425 or PF1394) when the Delay and Linearity requirements of paragraph F-3 or the IF bandwidth specifications of the Demodulator cannot be met or when the module has been repaired or replaced. An Oscilloscope, VHF Signal Generato Test Oscillator, VHF Sweep Generator, Step Attenuator, Delay and Linearity Test Set, Impedance Matching Network and 3900-Ohm Resistor are required for this procedure.

(1) Amplitude Response, Bandwidth And Insertion Loss Measurements

(a) Set up the equipment as shown in Figure 4-31.

(b) Adjust the AGC output of the Sweep Generator in conjunction with the Step Attenuator to produce 10 cm linear deflection on the Oscilloscope with the vertical sensitivity switch of the Oscilloscope set to the 1 MV position.

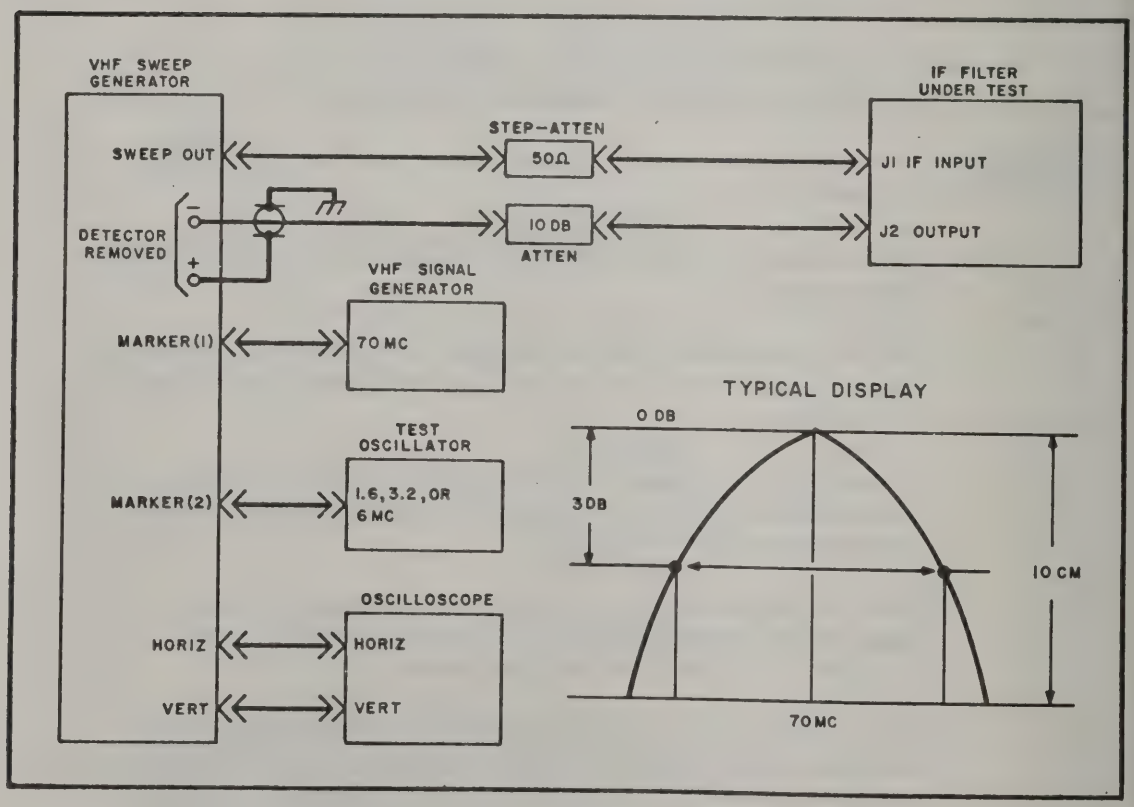


Figure 4-31. Linear Phase Filter Amplitude Response Test

(c) Using 3 db attenuation of the Step Attenuator, calibrate the VERTICAL GAIN CONTROL of the Oscilloscope for a 3-db deflection on the Oscilloscope. Restore Attenuator to original condition.

(d) Using the Frequency Counter, set the VHF Signal Generator for the 70-mc Marker (1). See Figure 4-31.

(e) Using the Frequency Counter, calibrate the Test Oscillator for a 1.6-mc marker when tuning PF1425 or a 3.2-mc marker when tuning PF1394. Connect the Test Oscillator to Marker (2). See Figure 4-31.

(f) Adjust marker amplitudes to obtain 3 markers on Oscilloscope. (70 mc ± Marker (2).)

(g) Set the Horizontal Deflection on the Oscilloscope and the width control on the Sweep Generator to space the 3 markers in such a way, so that the 2 markers on either side of center frequency lay on the 3 db down calibration line.

NOTE: From this point on, do not readjust the Horizontal Deflection on the Oscilloscope, Sweep Generator's Bandwidth Control or the 70-mc marker frequency control.

(h) Observe that a symmetrical bandwidth as shown in Figure 4-32 is obtained on the Oscilloscope Screen.

(i) If the requirement of step (h) is not met, proceed as follows:

1. Peak tune all shunt capacitors for maximum 70-mc amplitude response on the Oscilloscope Screen.

2. Adjust all coupling capacitors to obtain the correct bandwidth as shown in Figure 4-32.

NOTE: The Linear Phase IF Filter has fifteen variable capacitors: eight of which are shunt capacitors, located on the side walls of the shielding box and seven coupling capacitors, located on the inside of the box (in the earlier version of the IWCS equipment) or at the bottom outside of the box (in the later version of the IWCS equipment). See Figure 4-33 or 4-34 for orientation.

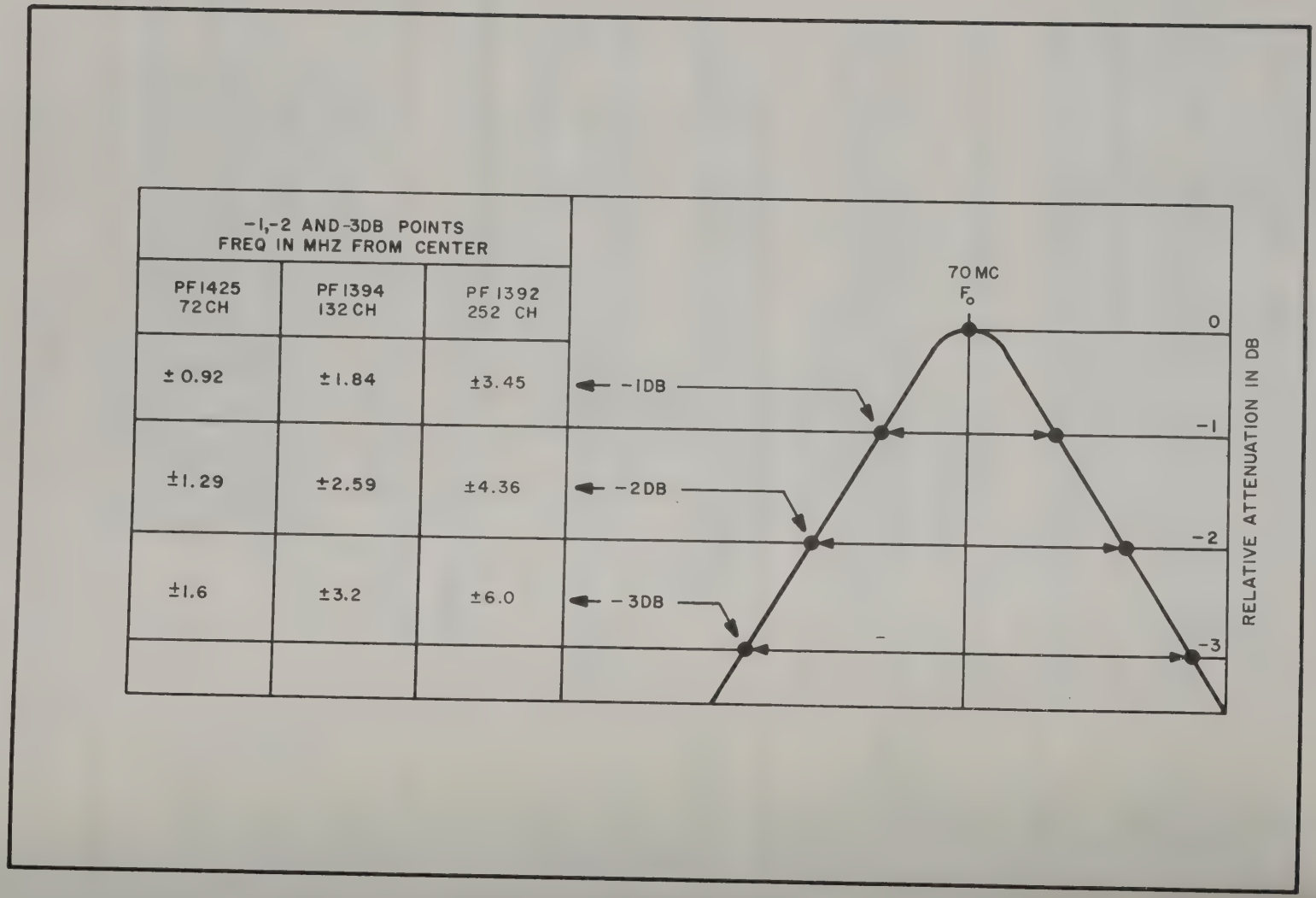
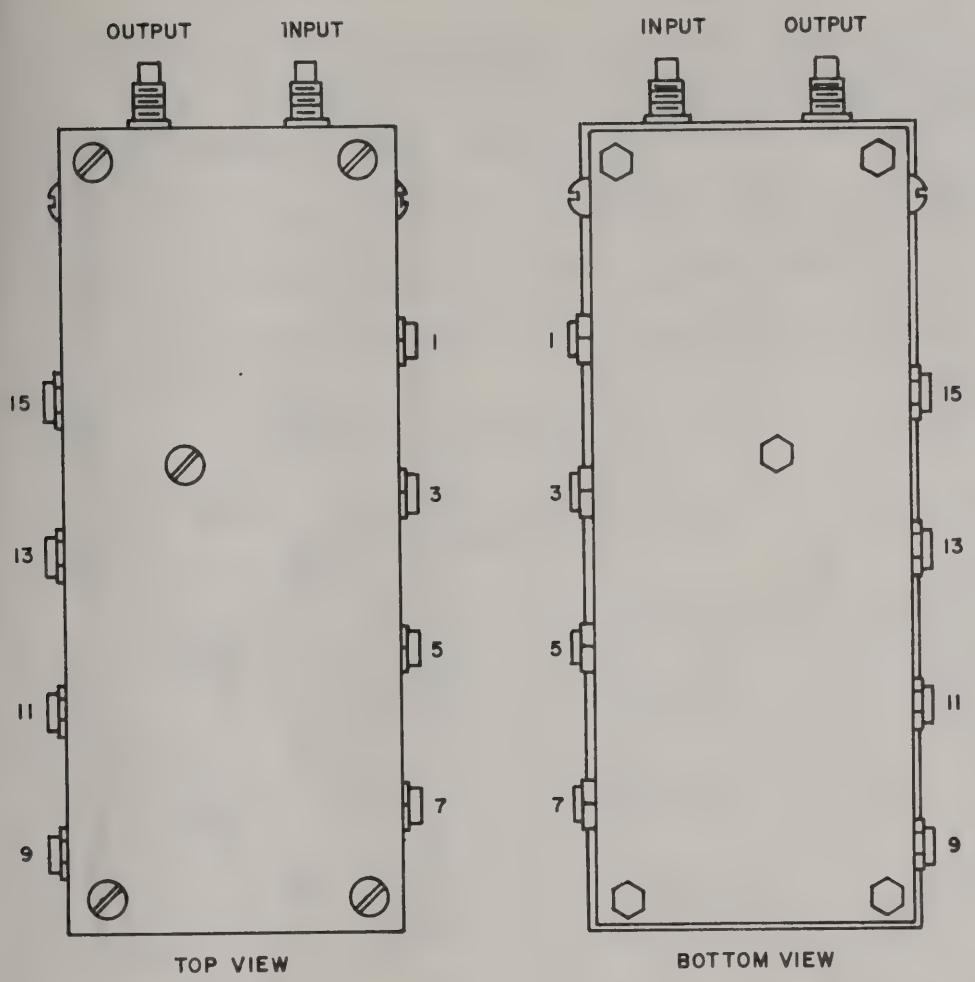
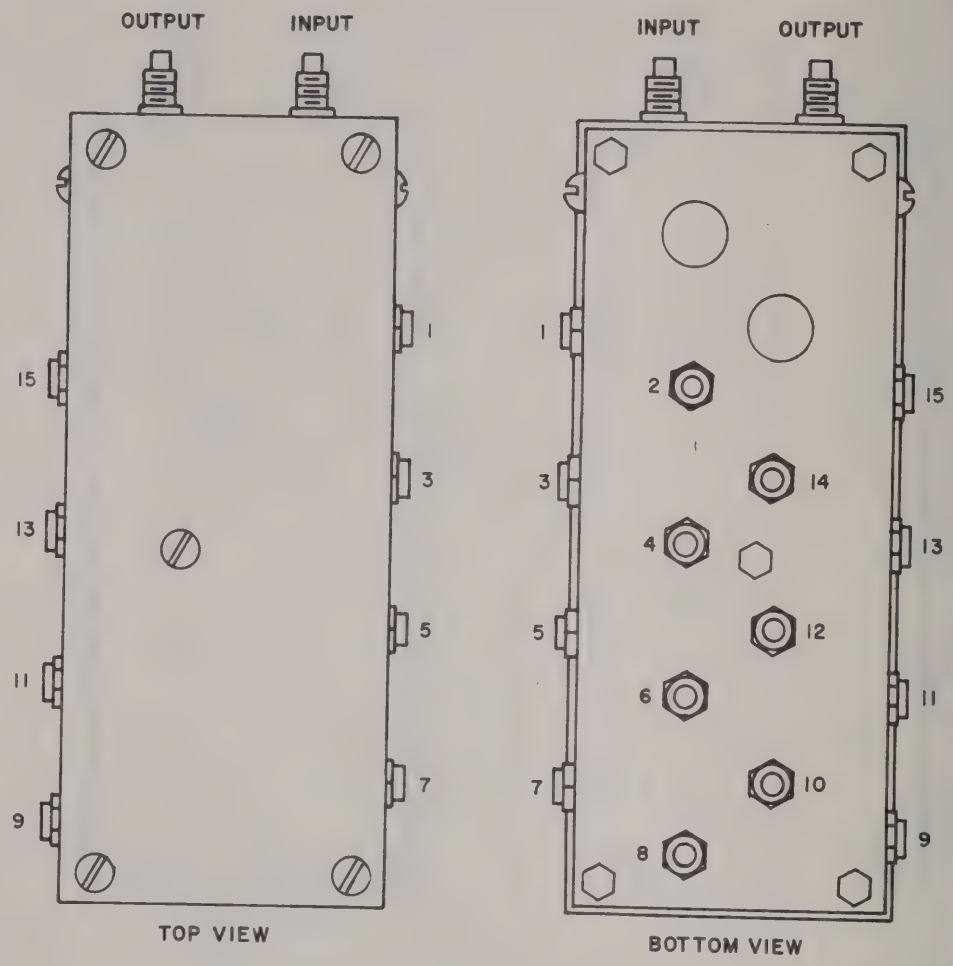


Figure 4-32. Linear Phase Filter Typical 3 DB Pass Line



NOTES:
1. ODD NUMBERED CAPACITORS (SHOWN)ARE SHUNT CAPACITORS
2. EVEN NUMBERED CAPACITORS (NOT SHOWN) ARE COUPLING CAPACITORS
3. COUPLING CAPACITORS ARE INSIDE THE SHIELDING BOX AND ARE AVAILABLE WHEN COVER IS REMOVED

Figure 4-33. IF Filter (Earlier Version) Configuration



NOTES:
1. ODD NUMBERED CAPACITORS ARE SHUNT CAPACITORS
2. EVEN NUMBERED CAPACITORS ARE COUPLING CAPACITORS

Figure 4-34. IF Filter (Later Version) Configuration

(j) Substitute a micon feed-through connector in place of the Linear Phase Filter.

(k) Read from Step Attenuator, the number of DB's required to reduce the vertical signal trace on the Oscilloscope to the same condition where the peak response of the filter was. This will indicate the filter insertion loss.

(l) The insertion loss of the filter should be between 17 and 20 db.

(m) Connect the equipment as shown in Figure 4-35.

(n) Measure the 10, 20, 30 and 40 db bandwidth of the Linear Phase Filter.

(o) Requirements: As specified in figure 4-36.

NOTE: Observe that no severe return lobes exist between the specified points.

(p) When all of the above requirements of the Linear Phase Filter in paragraph d have been met, disconnect all the test equipment and check the Delay and Linearity response of the Linear Phase Filter as described in paragraph F-4a, steps (q) through (s).

(q) When the Delay and Linearity requirements of the Linear Phase Filter are met, restore the Linear Phase Filter inside the drawer.

(r) If the Delay and Linearity requirements of the Linear Phase Filter as specified in paragraph F-4a, step (s) are not met, proceed as follows:

1. Set up the equipment as shown in figure 4-20 (including IF Filter under test).

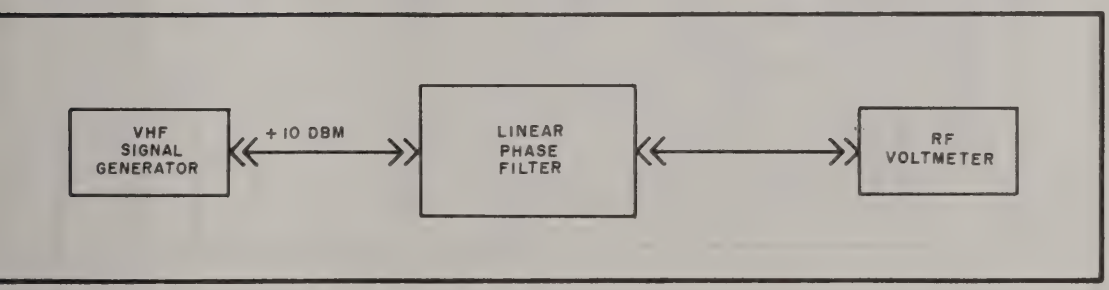


Figure 4-35. Linear Phase Filter 40-DB Bandwidth Test

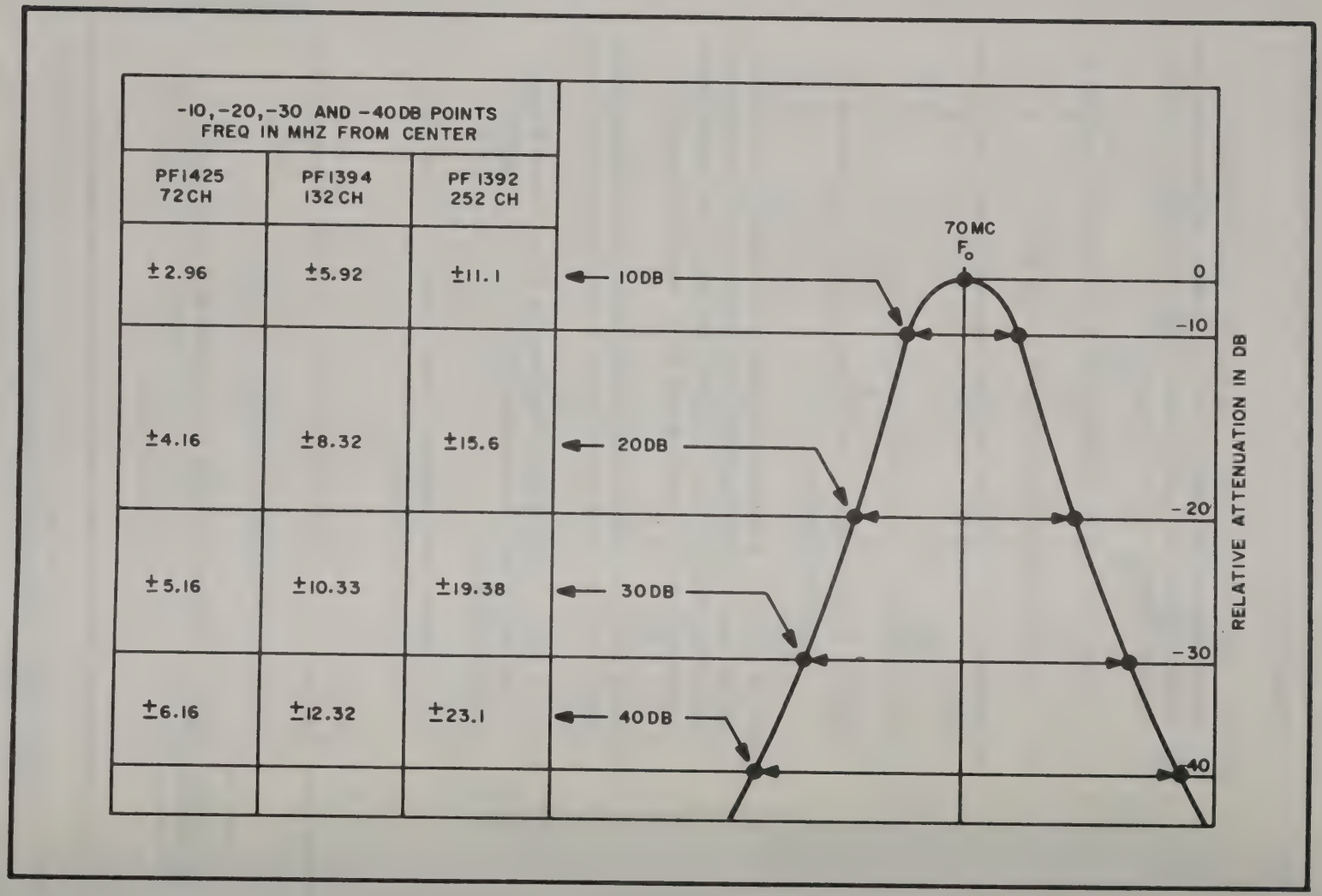


Figure 4-36. Typical 40-DB Down Response of Linear Phase Filter

2. Using figure 4-33 or 4-34 as a reference, remove all protective caps from the shunt tuning controls of the Linear Phase Filter. Store the caps in a safe area.

3. Starting with "Shunt 7" capacitor tune slightly "Shunt 7" control for an optimum delay response on the Oscilloscope Screen.

NOTE: In all cases count the amount of half turns in the clockwise or counter-clockwise direction so that if unsuccessful in the first attempt, the shunt tuning control can be returned to its original condition.

4. If "Shunt 7" tuning control does not produce the required performance, restore "Shunt 7" control to its original condition and tune "Shunts 5, 3, 1, 9, 11, 13 and 15" controls in that order, individually, for optimum delay and linearity on the Oscilloscope Screen. Refer to paragraph F-4a, step (s).

NOTE: "Shunt 1" through "Shunt 7" controls are less critical to bandwidth performance than "Shunt 9" through "Shunt 15" controls. It is therefore advisable to use the least critical (for bandwidth) controls for equalization of the IF Section delay characteristic. It will, however, be necessary to recheck the bandwidth characteristics of the Linear Phase Filter after completion of step (r).

5. If individual adjustment of the shunt tuning controls does not produce the required results, tune the coupling controls (8, 6, 4, 2, 10, 12 and 14) in that order, individually, for optimum delay and linearity on the Oscilloscope Screen. Refer to paragraph F-4a, step (s).

NOTE: "Coupling 2" through "Coupling 8" controls are less critical to bandwidth performance than "Coupling 10" through "Coupling 14" controls. It is therefore advisable to use the least critical (for bandwidth) controls for equalization of the IF Section delay characteristics. It will however be necessary to recheck the bandwidth characteristics of the Linear Phase Filter after completion of step (r).

6. Recheck the amplitude, bandwidth and insertion loss of the Linear Phase Filter.

7. Restore equipment to normal operation.

5. DC Control Voltage Alignment

The purpose of this procedure is to adjust the DC Control Voltage Network when the requirements for the performance test are not met. A UHF Signal Generator, Oscilloscope, AC VTVM with Probe, and DC VTVM are required for this procedure.

a. On the Demodulator, set COMBINER DEFEAT switch S1, RADIO PILOT DEFEAT switch S2, and NOISE AMPL PILOT DEFEAT switch S3 to DEFEAT. Set THRESHOLD EXT DEFEAT switch S4 to NORMAL. (Type 1130 only)

b. Connect the equipment as shown in figure 4-10.

c. Set the UHF Signal Generator to the assigned Receiver frequency at an output level of about -30 dbm. Check that the DC VTVM, connected to test point TP1 on the Driver-Discriminator, indicates zero (crossover).

d. Set the RF input level (making up for cable and 20-db Attenuator losses) to -91 dbm for 72 channels, or -88 dbm for 132 channels, or -85 dbm for 252 channels.

e. On Noise Amplifier (1), connect the High-Impedance Probe of the AC VTVM to INPUT TEST jack J10. The indication should be between 10 and 100 mv.

f. On Noise Amplifier (2), connect a DC VTVM to DC CONT VOLTAGE test point TP6.

g. On the Noise Amplifier Reflex and Recorder Amplifier, adjust DC CONTROL VOLTAGE ADJUST potentiometer R1 for an indication of -5 volts dc on the DC VTVM.

h. If the requirement is not met, proceed as follows:

(1) On Noise Amplifier (1), connect the High-Impedance Probe of the AC VTVM to INPUT TEST point TP10.

(2) On the Noise Amplifier-Reflex and Recorder Amplifier, adjust DC CONTROL VOLTAGE potentiometer R1 for an indication of 100 mv maximum on the AC VTVM.

(3) On Noise Amplifier (2), connect the DC VTVM to DC CONT VOLTAGE test point TP6 and adjust SLOPE ADJ potentiometer R15 for an indication of -5 volts dc.

i. Increase the RF input to the Frequency Converter to; -71 dbm for 72 channels, or -68 dbm for 132 channels, or -65 dbm for 252 channels.

j. On Noise Amplifier (2), the DC control voltage at test point TP6 should indicate a slope differential between the lower and upper limits of -2.4 to -2.6 vdc.

k. If the slope requirement (step j) is not met, reset the RF input level to the equipment to the level specified in step d. At test point TP6, the DC VTVM should indicate -5 volts dc. Perform step (1) or (2) and repeat step k and steps (1) or (2) until the slope requirement is met.

(1) If the DC control voltage at test point TP6 was less negative than -2.3 volts dc (toward zero), adjust SLOPE ADJ potentiometer R15 counterclockwise (in increments of 0.2 volts), until the DC VTVM indicates -5.2 volts. Readjust DC CONTROL VOLTAGE ADJUST potentiometer R1 for -5 volts dc and repeat steps i and j.

(2) If the DC control voltage at test point TP6 is more negative (away from zero), adjust SLOPE ADJ potentiometer R15 clockwise (in increments of 0.2 volts), until the DC VTVM indicates -4.8 volts. Readjust DC CONTROL VOLTAGE ADJUST potentiometer R1 for -5 volts dc and repeat steps i and j.

l. When all requirements have been met, plot the complete DC control voltage curve as described in the DC Control Voltage Test (paragraph E-6).

m. When all requirements have been met, remove all test equipment and restore all cables and switches for normal operation.

6. Metering Adjustment

NOTE: Refer to paragraph L1 for the metering adjustment procedure.

The purpose of this procedure is to calibrate the front-panel meter on the Demodulator when the requirements of a performance test are not met or before adjusting the Pilot Level and Reflex Circuits. Only switch positions requiring calibration are recognized in this procedure. An Oscilloscope, 10-db Attenuator, Oscillator, and a VTVM are required for this procedure. Before performing this procedure, check the deviation of the Modem for the proper value.

a. Connect the Oscilloscope to test point TP6 on the Chopper Demodulator and adjust SYMMETRY ADJ potentiometer R5 for a symmetrical square wave on the Oscilloscope.

b. Connect the test equipment as shown in figure 4-4, option 3.

c. On the Modem's Test Exciter, deactivate the Radio Pilot circuit by connecting the shorting cap P40 to RADIO PILOT DEFEAT jack J32.

d. Set the Oscillator to 12 kc at an output level of -45 dbm. The measured baseband output level should be -15 dbm.

e. Set FUNCTION SELECTOR switch S1 to position 7. If necessary, adjust METER CAL potentiometer R24 on the Meter Amplifier and Detector module for a zero indication on the front-panel meter.

f. Set FUNCTION SELECTOR switch S1 to position 8. If necessary, adjust GAIN ADJ potentiometer R5 on the Meter Amplifier and Detector Module for an indication of 7 on the front-panel meter. This sets the test tone level reference.

g. Set FUNCTION SELECTOR switch S1 successively to positions 3, 4, 5 and 6. The front-panel meter should indicate in the green color band. If any of the requirements are not met, proceed as follows:

(1) Remove the Pilot Interlock cable from Pilot Reflex connector CP3.

(2) Turn off the Power Supply-Blower.

(3) Remove the four front panel screws and remove the Meter Module.

(4) Turn on the Power Supply and adjust METER DC SENSITIVITY potentiometer R21 until the requirements are met for each of the switch positions (step g).

(5) Turn off the Power Supply-Blower and reinsert the Meter Module.

(6) Turn on the Power Supply-Blower.

(7) Reconnect the Pilot Interlock cable to connector CP3.

NOTE: Steps (1) and (7) will not be required when ECN No. 15212 is incorporated.

(8) When all requirements have been met, remove all test equipment and restore all switches for normal operation.

Radio Pilot Level and Reflex Circuit Adjustment

OTE: ECN No. 15212 was issued to prevent damage to CR4 and CR5 of the Pilot Amplifier Module. The ECN adds a diode in the B+ line which prevents damage to CR4 and CR5 when disconnecting the Pilot interconnect.

OTE: Refer to paragraph L3 for pilot reflex adjustment procedure.

The purpose of this procedure is to make sure that the Receiver will be taken f the line (Combiner will be muted) upon failure of the distant-end carrier and nsequent loss of pilot, so that the high noise level will not be fed to the Baseband mplifier.

Since the radio pilot adjustment depends on the proper operation of the front-nel meter, it is important to check the Metering Adjustment (paragraph F-6) before oceeding with this alignment. The Modem, a DC VTVM and a 10-db Attenuator are quired for this procedure.

a. Connect IF OUTPUT J22 on the Modem through the 10-db Attenuator to 70 MC INPUT connector CP6 on the Receiver Housing.

b. On the Modem, activate the radio pilot and make sure it is 10 db below test tone. It should measure -25 dbm (75Ω) at BASEBAND OUTPUT connector CP4 on the Receiver Housing.

c. On the Demodulator, set RADIO PLT DEFEAT switch S2 to NORMAL. Set NOISE AMPL DEFEAT switch S3, and COMBINER DEFEAT switch S1 to DEFEAT.

d. Make sure that all Pilot Reflex Interconnect Cables are connected.

e. On the Monitor Control Module, insert built-in test probe E2 (red) in test point TP17 and test probe E1 (black) in test point TP37.

f. Set FUNCTION SELECTOR switch S1 to position 11.

g. On the Pilot Amplifier, adjust PILOT LVL ADJ potentiometer R7 for an indication of 7 on the front-panel meter. RAD PLT FAULT lamp DS12 should be off.

h. Connect a DC VTVM between test point TP10 on the Combiner and ground.

i. Adjust PILOT LVL ADJ potentiometer R7 for an indication of approximately 5 on the front-panel meter. The DC VTVM should indicate -6 to -8 volts nominal. After 2 seconds, RADIO PILOT FAULT lamp DS12 should go on. If the lamp does not go on:

(1) Adjust PILOT REFLEX ADJ potentiometer R32 on the Pilot Amplifier until the requirement is met.

(2) If the indicator does not go on when potentiometer R32 is adjusted, there is a malfunction in the Pilot Amplifier. Repair or replace the Pilot Amplifier and repeat steps g through i.

j. Readjust PILOT LVL ADJ potentiometer R7 for an indication of 7 on the front-panel meter. The DC VTVM should indicate between -0.5 and -1.5 volts dc, depending on the Noise Amplifier pilot reflex adjustment. This is the correct setting for the Radio Pilot level.. Observe that RADIO PILOT FAULT lamp DS12 goes out within 2 seconds.

k. Set NOISE AMPL PLT DEFEAT switch S3 to NORMAL. The DC VTVM (at Combiner test point TP10) should indicate -1.5 volts when the pilot tone is present. If the requirement cannot be met:

(1) Check the Noise Amplifier DC Control Voltage Alignment (paragraph F-6).

(2) Adjust PLT REFLEX LVL ADJ potentiometer R22 on the Noise Amplifier, Reflex and Recorder Amplifier until the requirement is met.

(3) If the out-of-band noise is below -60 dbm or less than 1.5 volts, make the reflex circuit inoperative as follows:

NOTE: This pilot adjustment is normally made so as to assure that the Combiner will be meted in the event of Noise Amplifier failure. However, to make the muting and fault alarm relays function reliably, output pilot voltages in excess of 1.5 V are required. In order to permit useful combining below about -60 dbm (i.e. below which, DC control voltage due to out-of-band noise alone is less than 1.5V), which is considered more useful, the reflex circuit is made inoperative and the amount of pilot fed through the Noise Amplifier is adjusted only to a value which makes the DC control voltage floor, equal in all Receivers, and as low in value as possible.

(a) Connect the DC VTVM between DC CONTROL VOLTAGE test point TP6 and ground on Noise Amplifier (2).

(b) Adjust PLT REFLEX LVL potentiometer R22 on the Noise Amplifier Reflex and Recorder Amplifier Card for one volt. If this is impossible due to the residual noise level of the Noise Amplifiers, up to 1.3 volts is acceptable.

NOTE: Potentiometer R22 must be set to such a point that it does not add to the indication at test point TP6.

(c) If the residual noise indication of the Noise Amplifier in one Receiver is slightly higher than the other, but not greater than 1.3 volts, adjust the other Receivers to the same value by adjusting potentiometer R22 (adding pilot) on the Noise Amplifier Reflex and Recorder Amplifiers in the other Receivers.

l. Disconnect Plug P24 on Cable W16 from INPUT jack J1 on Noise Amplifier (1).

m. On the Noise Amplifier Reflex and Recorder Amplifier, adjust PLT REFLEX ADJ potentiometer R7 until NOISE AMPL PLT FAULT indicator DS11 just goes on.

n. Reconnect Plug P24 on Cable W16 to INPUT jack J1 on Noise Amplifier (1). NOISE AMPL PLT FAULT indicator DS11 should go off.

o. Disconnect all test equipment and restore all switches for normal operation.

Threshold Extension Circuit Alignment (Type 1130 only)

The purpose of this procedure is to align the AFC circuit and adjust the loop in of the Threshold Extension Circuit when the requirements of the performance st are not met. An AC VTVM, DC VTVM, RF Voltmeter, Frequency Counter, odem and 10-db Attenuator are required for this procedure.

OTE: If a Modem is not available, an REL Exciter that has been thoroughly checked and is operating properly can be substituted. Refer to the Exciter Instruction Manual for circuit connections.

a. On the Modem:

(1) Deactivate the Radio Pilot circuit on the Test Exciter by connecting the shorting cap P40 to RADIO PILOT DEFEAT jack J32.

(2) Set the CHAN CAPACITY SELECTOR switch S5 to the position representing the channel capacity of the system under test.

b. On the Receiver, set COMBINER DEFEAT switch S1, RADIO PILOT DEFEAT switch S2, and NOISE AMPL DEFEAT switch S3 to DEFEAT. Set THRESHOLD DEFEAT switch S4 to TEST.

c. Connect a 70-mc output from the Modem through a 10-db Attenuator to IF INPUT connector J31 on the Demodulator.

d. Connect the Frequency Counter to RF MON jack J1 on the AFC Reference Oscillator. The indication should be 50.25 mc ±200 cps. If the requirement is not met align the AFC Reference Oscillator as follows:

(1) Connect the RF Voltmeter to RF MON jack J1. The limits are 10 to 35 mv.

(2) Connect the RF Voltmeter to RF OUTPUT jack J2 and peak OUTPUT ADJ capacitor C12. The limits are 250 to 350 mv.

(3) Reconnect the output cable to RF OUTPUT jack J2 and connect a Frequency Counter to RF MON jack J1.

(4) Adjust FREQ VER capacitor C5 for a frequency of 50.25 mc ±200 cps.

e. On the front panel of the Demodulator, set FUNCTION SELECTOR switch S1 to position 10. The indication on front-panel meter M1 should be no more than 2 times 10 or 20 kc. If necessary, adjust VCO BIAS COARSE ADJ potentiometer R8 for a minimum indication.

f. Set FUNCTION SELECTOR switch S1 to position 9. The indication on the front-panel meter M1 should be no more than 5 times 1 or 5 kc. If necessary, adjust VCO BIAS FINE ADJ potentiometer R11 for a minimum indication.

g. If the VCO frequency drift is consistent, align the AFC circuit as follows:

(1) Connect the Frequency Counter to FREQUENCY TEST jack J4 on the Buffer Amplifier.

(2) Set FUNCTION SELECTOR switch S1 to position 9.

(3) Set GAIN ADJ potentiometer R14 on the Error Amplifier fully counter-clockwise (CCW) for maximum gain.

(4) Adjust VCO BIAS COARSE potentiometer R8 and VCO BIAS FINE potentiometer R11 on the Buffer Amplifier for minimum indication on the front-panel meter M1.

(5) The indication on the Frequency Counter should be 50.25 mc ±500 cps. If necessary, adjust FREQ BAL potentiometer R29 on the Chopper Demodulator until the error frequency is within limits.

(6) Set the DC VTVM to the lowest voltage range and connect it to DISC test point TP5 on the AFC Driver Discriminator. It should indicate 0 volts ±100 mv dc. If the limits cannot be met:

(a) Connect a DC VTVM to DRIVER test point TP4 and tune DISCR PRIMARY capacitor C14 for maximum negative indication.

(b) Connect the DC VTVM to DISCR test point TP5 and tune DISCR SECONDARY capacitor C15 for zero volts on the DC VTVM.

(7) The Frequency Counter should indicate 50.25 mc ±500 cps.

h. Check the gain of the Error Amplifier as follows:

(1) Connect the AC VTVM to test point TP9 and measure the level.

(2) Connect the AC VTVM to test point TP8 and hold pressed RED pushbutton S1 on the Buffer Amplifier while measuring the level.

(3) Compute the gain (level step 1 minus level step 2). It should be between 38 and 40 db.

i. On the Buffer Amplifier, connect the Frequency Counter to FREQUENCY TEST jack J4.

j. Readjust VCO BIAS COARSE ADJ potentiometer R8 and VCO BIAS FINE ADJ potentiometer R11 for a +5 kc change (from 50.25 mc) as indicated on the Frequency Counter.

k. On the Meter and Switch Assembly, set AFC CALIB potentiometer R15 for a full scale indication on front-panel meter M1 (switch position 9).

l. On the Buffer Amplifier, reset VCO BIAS COARSE ADJ potentiometer R8 and VCO BIAS FINE ADJ potentiometer R11 for a Frequency Counter indication of 50.25 mc.

m. On the Buffer Amplifier, connect the RF Voltmeter to OUTPUT connector J1. The indication should be 200 mv nominal.

n. On the Shaping Filter, connect the RF Voltmeter to P64 on cable W36. The indication should be 40 mv nominal. If the requirement is not met, replace the Shaping Filter.

o. Disconnect the cable from INPUT jack J1 on the Limiter-Discriminator and connect the cable to the RF Voltmeter.

p. Peak-tune CENTER FREQ ADJ capacitor C12 on the Bandwidth Selector and adjust COUPLING ADJ capacitor C16 on the Mixer for a 60 mv indication on the RF Voltmeter. Reconnect the cable to J1 on the Limiter-Discriminator.

q. Connect the equipment as shown in figure 4-9 (option 3). Set the Oscillator for 80 kc at a level of -45 dbm (75Ω) or 1.55 mv. The baseband output level should be -15 dbm (75Ω) 49 mv ±0.5 db.

r. Press COMPR TEST pushbutton S1 (black) on the Limiter-Discriminat The change in the baseband output level should be 5.5 to 6.0 db. If the limits are not met, adjust COMPR LEVEL potentiometer R85.

s. Reset GAIN ADJ potentiometer R5 on the Wideband Amplifier until the baseband output level is the same as in step q.

FREQUENCY CONVERTER TEST AND ALIGNMENT PROCEDURE

Test and alignment procedures are performed when the requirements of a rformance test are not met and the trouble is localized to the Frequency Converter. l test and alignment procedures are performed with the equipment out of service. e figure 4-1 for the location of the individual components in the Frequency Converter awer. The same power supply is used for operating voltages of the Frequency Con- rter as for the Modulator. For test and adjustment of the Power Supply-Blower ltages, refer to paragraph I.

Injection Chain Test and Alignment

The purpose of this procedure is to test and, if necessary, align the frequency, set the levels of the local oscillator injection chain when the requirements of a rformance test are not met. Prior to performing any of these procedures, make re that the crystal oven temperature has stabilized. This may be verified by ob- rving that the crystal oven indicator is cycling on and off. For all measurements, t the range selector of the microwave power meter to the highest range. Ascertain t the low range scales are zeroed properly before use. Check the operation of the ving unit before attempting to align the unit under test. A Frequency Counter with 5 to 60 mc Converter, a Frequency Meter, a Microwave Power Meter with a ermistor Mount, a 30-db RF Attenuator, a 10-db RF Attenuator, a 3-db RF Attenu- r, a Multimeter and a DC VTVM are required for these procedures.

a. Oscillator-Doubler Test and Alignment

Unless otherwise noted, all controls and connectors in the following pro- dures are located on the Oscillator-Doubler module.

(1) Connect a Microwave Power Meter through an N female to Micon female adapter to RF OUTPUT connector J2.

(2) Connect a Frequency Counter to RF MON connector J1.

(3) The power indication at connector J2 should be between 2 and 5 mw. The frequency indication at connector J1 should be the assigned crystal frequency within ±200 cps.

NOTE: In case of an emergency, the crystal frequency within ±1000 cps is acceptable.

(4) If the requirements are met, proceed to step (5). If the requirements are not met, proceed as follows:

(a) Set FREQ VER capacitor C5 to the mechanical center position, (approximately 5 turns in the clockwise direction from minimum capacity setting).

(b) Tune FREQ ADJ capacitor C6 and OUTPUT ADJ capacitor C12 for a peak indication on the Microwave Power Meter. The indication should be between 2 and 5 mw.

(c) If necessary, reset FREQ VER capacitor C5 for an indication on the Frequency Counter within ±200 cps of the frequency marked on the crystal. The setting of capacitor C5 should occur within 1 db of the peak power output obtained in step (b).

(d) If necessary, readjust OUTPUT ADJ capacitor C12 for a peak power indication on the Microwave Power Meter between 2 and 5 mw. If an adjustment of capacitor C12 is required, recheck the crystal frequency at connector J1.

(5) Remove all test equipment and reconnect the Oscillator Doubler for normal operation.

(6) Set FUNCTION SELECTOR switch S1 on the Frequency Converter to position 8 and, if necessary, adjust potentiometer R5 on the Monitor Control (figure 4-1) for an indication within the red color band on STATUS INDICATOR meter M1 of the Frequency Converter.

b. LF Amplifier Test and Alignment

Unless otherwise specified, all controls and connectors in the following procedures are located on the LF Amplifier.

(1) Set circuit breakers CB3 and CB4 on the Power Supply-Blower to OFF. This removes the power supply voltages to the LF Amplifier.

(2) Connect the Microwave Power Meter through a 30-db RF Attenuator to the output of Attenuator AT1.

(3) Set the range switch on the Microwave Power Meter to the 1-mw position.

(4) Set circuit breakers CB3 and CB4 on the Power Supply-Blower to ON.

(5) The Microwave Power Meter should indicate between 0.35 and 0.5 mw (corresponding to a 350 to 500 mw output level). If the requirement is met, proceed to step (6). If the requirement is not met, proceed as follows:

(a) Adjust the variable capacitors, in the sequence given in the following listing, for a peak indication on a DC VTVM connected between the specified TEST jack and GRD jack TP1.

Capacitor	Test Jack	Requirement
INPUT C5	AMPL (1) TEST TP2	-0.5 vdc min
INTERSTAGE C18	AMPL (2) TEST TP3	-0.1 vdc min
OUTPUT C26	AMPL (3) TEST TP5	-0.5 vdc min

(b) Readjust INPUT capacitor C5, INTERSTAGE capacitor C18 and OUTPUT capacitor C26 for maximum power indication on the Microwave Power Meter.

(c) Reset GAIN ADJ potentiometer R15 for an indication on the Microwave Power Meter at 0.42 mw (corresponding to 420 mw output). Repeat step (b).

(d) If the LF Amplifier output power requirement of 420 mw cannot be met, although the requirements of paragraph G-1a are satisfied, the LF Amplifier should be replaced with a spare unit and the defective module repaired.

(6) Set circuit breakers CB3 and CB4 on the Power Supply-Blower to OFF.

(7) Remove all test equipment and reconnect the LF Amplifier for normal operation.

(8) Set circuit breakers CB3 and CB4 on the Power Supply-Blower to ON.

(9) Set FUNCTION SELECTOR switch S1 on the Frequency Converter to position 7 and adjust, if necessary, potentiometer R4 on the Monitor Control (figure 4-1) for an indication within the red color band on STATUS INDICATOR meter M3 on the Converter-RF Amplifier.

c. SRD Multiplier Test and Alignment

Unless otherwise noted, all controls and connectors in the following procedure are located on the SRD Multiplier.

(1) Set circuit breakers CB3 and CB4 on the Power Supply-Blower to OFF. This removes the power supply voltages to the injection string.

(2) Connect the Microwave Power Meter, through a 30-db RF Power Attenuator, to the output of 3- db Attenuator AT1.

(3) Set the range switch on the Microwave Power Meter to the 1-mw scale.

(4) Set circuit breakers CB3 and CB4 on the Power Supply-Blower to ON.

(5) Measure 0.35 to 0.5 mw (corresponding to 350 to 500 milliwatts) on the Microwave Power Meter.

(6) If the requirement of step (5) is not met, refer to paragraph G-1b. If the requirement is met, record the power output level for future reference.

(7) Connect an AC-DC VTVM to test point TP5 on the LF Amplifier.

(8) Observe the indication on the AC-DC VTVM. It should be a minimum of 0.5 volts DC. Record the exact reading since it will be used as a reference for the following procedure.

(9) Set circuit breakers CB3 and CB4 on the Power Supply-Blower to OFF.

(10) Reconnect Attenuator AT1 to the SRD Multiplier input.

(11) Connect the equipment as shown in figure 4-37.

(12) Set the range selector switch on the Microwave Power Meter to the 1-mw scale.

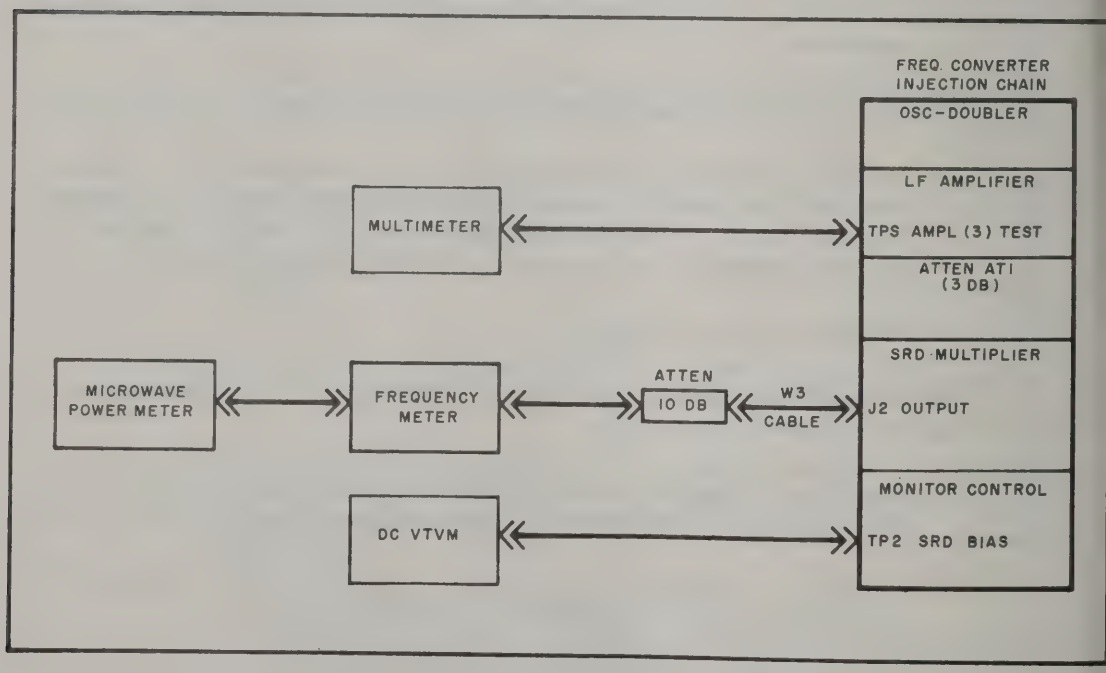


Figure 4-37. SRD Multiplier Alignment

(13) Set the Frequency Meter to about 50 mc above or below the SRD Multiplier output frequency.

NOTE: The SRD Multiplier output frequency is the exciter carrier frequency plus or minus 70 mc. The SRD Multiplier multiplication factor is 17, 18, 19, or 21, depending on the carrier frequency.

(14) Set circuit breakers CB3 and CB4 on the Power Supply-Blower to ON.

(15) The Microwave Power Meter should indicate between 2.5 and 4.0 mw (corresponding to a 25 to 40 mw output level).

(16) Set the Frequency Meter to the SRD Multiplier output frequency and observe that a dip of 2 db or greater is obtained on the Microwave Power Meter.

(17) Continue to tune the Frequency Meter ±60 mc above and below the SRD Multiplier output frequency and observe that no other dip (except that of the output frequency) is obtained. This signifies the obsence of spurious frequency outputs or noise.

(18) Set circuit breaker CB2 on Power Supply-Blower to OFF.

(19) Restore power by setting circuit breaker CB2 on Power Supply-Blower to ON and check that the SRD Multiplier power output returns immediately (no lower output steps) to its original condition as observed in step (15). This signifies that the SRD Multiplier is operating in a stable condition.

(20) Observe the reading on the AC-DC VTVM connected to TP5 of the LF Amplifier. It should be approximately the reading observed in step (8), when the LF Amplifier was connected to the 50Ω termination of the 13-db Attenuators (consisting of AT1 and a 10-db Attenuator) and Microwave Power Meter.

(21) Record the reading at TP5 for future reference.

NOTE: This test signifies that the input impedance of the SRD Multiplier is properly matched to 50 ohms.

(22) Locate and unlock GAIN ADJ potentiometer R15 on the LF Amplifier.

(23) Set circuit breakers CB3 and CB4 on the Power Supply-Blower to OFF.

(24) Connect the Microwave Power Meter, through a 30-db RF Attenuato to the output of the 3-db Power Attenuator AT1.

(25) Set the range switch on the Microwave Power Meter to the 1-mw scale.

(26) Set circuit breakers CB3 and CB4 on Power Supply-Blower to ON.

(27) Adjust GAIN ADJ potentiometer R15, on the LF Amplifier, for a power level of 1 db above LF Power Amplifier output level observed in step (6).

(28) Set circuit breakers CB3 and CB4 on the Power Supply-Blower to OFF.

(29) Reconnect Attenuator AT1 to the SRD Multiplier input.

(30) Observe that the power output level is within approximately ±1 db of the SRD Multiplier output level observed in step (15).

(31) Set circuit breakers CB3 and CB4 on Power Supply-Blower to OFF.

(32) Connect a 3-db RF Attenuator between plug P3 of cable W2 and 3-db Attenuator AT1.

(33) Set circuit breakers CB3 and CB4 on the Power Supply-Blower to ON.

(34) Observe that the power output level is approximately 2 to 3 db below the SRD Multiplier output level observed in step (15).

(35) Repeat steps (16) through (19).

(36) Steps (27) through (35) signify that the SRD Multiplier operation is very stable.

(37) Set circuit breakers CB3 and CB4 on the Power Supply-Blower to OFF.

(38) Remove the 3-db RF Attenuator (between W2 and AT1).

(39) Connect the Microwave Power Meter, through a 30-db RF Attenuator, to the output of 3-db Attenuator AT1.

(40) Set the range switch on the Microwave Power Meter to the 1-mw scale.

(41) Set circuit breakers CB3 and CB4 on Power Supply-Blower to ON.

(42) Adjust GAIN ADJ potentiometer R15 on the LF Amplifier for the same level as observed in step (6). Reconfirm this measurement by observing the same DC reference voltage at TP5 of the LF Amplifier observed in step (8).

(43) Set circuit breakers CB3 and CB4 on the Power Supply-Blower to OFF.

(44) Reconnect Attenuator AT1 to SRD Multiplier input.

(45) Set circuit breakers CB3 and CB4 on the Power Supply-Blower to ON.

(46) Recheck steps (15) through (20).

(47) If the requirements of steps (15) through (46) were met, proceed to step (50). If the requirements were not met, proceed as follows:

(a) Set the Frequency Meter to approximately 50 mc above or below the SRD Multiplier output frequency.

(b) Slightly adjust the tuning controls on cavities Z2 and, if necessary, Z1 for maximum power output as indicated on the Microwave Power Meter.

(c) Scan the output with the Frequency Meter to establish that the SRD Multiplier is tuned to the required output frequency. If it is not, resume simultaneous tuning of cavities Z1 and Z2 until the desired SRD Multiplier output frequency is reached.

(d) Recheck steps (15) through (20).

(48) If the requirements of steps (47)(a) through (d) were met, proceed to step (50). If the requirements were not met, proceed as follows:

(a) Connect a DC VTVM, to SRD BIAS test point TP2 on the Monitor Control.

(b) If no bias indication is observed on the DC VTVM, adjust bias control R1 to obtain an indication between -0.5 and -2.5 vdc.

NOTE: When adjusting bias control potentiometer R1 or pi-network capacitor C2, observe that the dc reference voltage at TP5 of the LF Power Amplifier is approximately the level observed in step (8).

(c) Set the Frequency Meter to approximately 50 mc above or below the SRD Multiplier output frequency.

(d) Alternately adjust the tuning controls on cavities Z1 and Z2 for maximum power output as indicated on the Microwave Power Meter.

(e) Scan the output with the Frequency Meter to establish that the SRD Multiplier is tuned to the required output frequency. If it is not, resume simultaneous tuning of cavities Z1 and Z2 until the desired SRD Multiplier output frequency is reached.

(f) Detune the Frequency Meter to approximately 50 mc above or below the SRD Multiplier output frequency.

NOTE: From this point onwards, make frequency checks with the Frequency Meter to insure that the SRD Multiplier is still operating at the SRD Multiplier output frequency.

(g) Rotate potentiometer R1 clockwise until the bias indication on the DC VTVM is reduced to zero volts dc.

(h) In small increments, rotate potentiometer R1 in a counterclockwise direction for a maximum indication on the Microwave Power Meter.

(i) Observe that the bias voltage is between -0.5 and -2.5 volts dc and that the indication on the AC-DC VTVM at TP5 of the LF Amplifier is approximately the reading recorded in step (8).

(j) Slowly rotate capacitor C2 in a counterclockwise direction for maximum power output as indicated on the Microwave Power Meter. Make certain that the observed conditions of step (48)(f) are met.

(k) In small increments, alternately adjust capacitor C2 and potentiometer R1 for a maximum indication on the Microwave Power Meter.

NOTE: Several maximum settings may be obtained with capacitor C2 and potentiometer R1. The optimum setting will be such that the power output will plateau rather than go through a sharp peak. At the same time, the voltage indication on the DC VTVM, monitoring TP5 on the LF Amplifier, will correspond very closely (within ±0.3 volts dc) with the original voltage reference when terminated into 50Ω as observed in step (8). Slight changes in the setting of capacitor C2 and potentiometer R1 may be necessary to achieve this condition.

(l) Adjust RF output tuning control C6 (by rotating output connector J2), in conjunction with tuning control on output cavity Z2, for maximum power output as indicated on the Microwave Power Meter. A minimum power output level of 25 mw is required.

(m) Slightly reoptimize the tuning controls on cavities Z1 and Z2 for maximum power output.

(n) Rotate output coupling control C6 at connector J2 to determine the direction in which the power output as observed on the Microwave Power Meter decreases smoothly. The final setting of output coupling control C6 is at a point where the power is between 0.3 db and 0.5 db below maximum output power in the smoothly decreasing direction.

(o) Measure the output power on the Microwave Power Meter. It should be between 2.5 and 4 mw (corresponding to a 25-mw to 40-mw output level).

(p) Recheck for results specified in steps (16) through (46). These results signify the absence of spurious outputs and that the SRD Multiplier is tuned for stable operation.

(49) If the requirements of steps (15) through (46) were met, proceed to step (50). If the requirements were not met, proceed as follows:

(a) Set the Frequency Meter to approximately 50 mc above or below the SRD Multiplier output frequency.

(b) Very slightly, readjust the input slider, pausing at each small interval to retune Z1 for a peak power indication on the Microwave Power Meter.

(c) In small increments, alternately adjust potentiometer R1 and capacitor C2 for a maximum indication on the Microwave Power Meter.

(d) Observe that the bias voltage at test point TP2 is between -0.5 and -2.5 volts dc and that the indication at test point TP5 of the LF Amplifier is close to within ±0.3 volts DC to the indication recorded in step (8).

(e) If necessary, retune output coupling tuning control C6, at output connector J2, in conjunction with tuning control Z2 to obtain maximum power output on the Microwave Power Meter.

(f) Readjust output coupling control C6, at connector J2, to determine the direction in which the power output, as observed on the Microwave Power Meter, decreases smoothly. The final setting of output coupling control C6 is at a point where the power output is between 0.3 db and 0.5 db below maximum output power in the smoothly decreasing direction.

(g) Recheck the results specified in steps (15) through (46). These results signify the absence of spurious outputs and that the SRD Multiplier is tuned for stable operation.

(h) If instability is still indicated, new settings of capacitor C2 and potentiometer R1 may be required.

(50) Disconnect the test equipment and restore circuit connections.

(51) On the Frequency Converter, set FUNCTION SELECTOR switch S1 to position6 and, if necessary, adjust potentiometer R2, on the Monitor Control (figure 4-1), for an indication within the red color band on STATUS INDICATOR meter M1 of the Frequency Converter.

(52) On the Frequency Converter, set FUNCTION SELECTOR switch S1 to position 12 and, if necessary, adjust potentiometer R6, on the Monitor Control (figure 4-1), for an indication on STATUS INDICATOR meter M1, within the red color band, with the test probe (red) connected to TP2 on the Monitor Control.

2. Frequency Converter Measurements and Adjustment Procedure

The purpose of this procedure is to measure the performance characteristics of the Frequency Converter and to make the required adjustments if the gain, bandwidth, or any other frequency converter characteristics are not within specifications. Please note that a complete alignment procedure required only when changing frequency is treated separately in paragraph H.

An RF Sweep Generator, Frequency Meter, Oscilloscope Detector, UHF Signal Generator, RF Voltmeter, and a 30-db Attenuator are required for this procedure.

a. Bandwidth and Symmetry Measurement

(1) Connect the equipment as shown in figure 4-38.

(2) Set the Sweep Generator for operation about the desired RF signal frequency f_o, and adjust the Sweep Generator output power setting to provide a nominal -45 dbm power level at the output of the 30-db Attenuator.

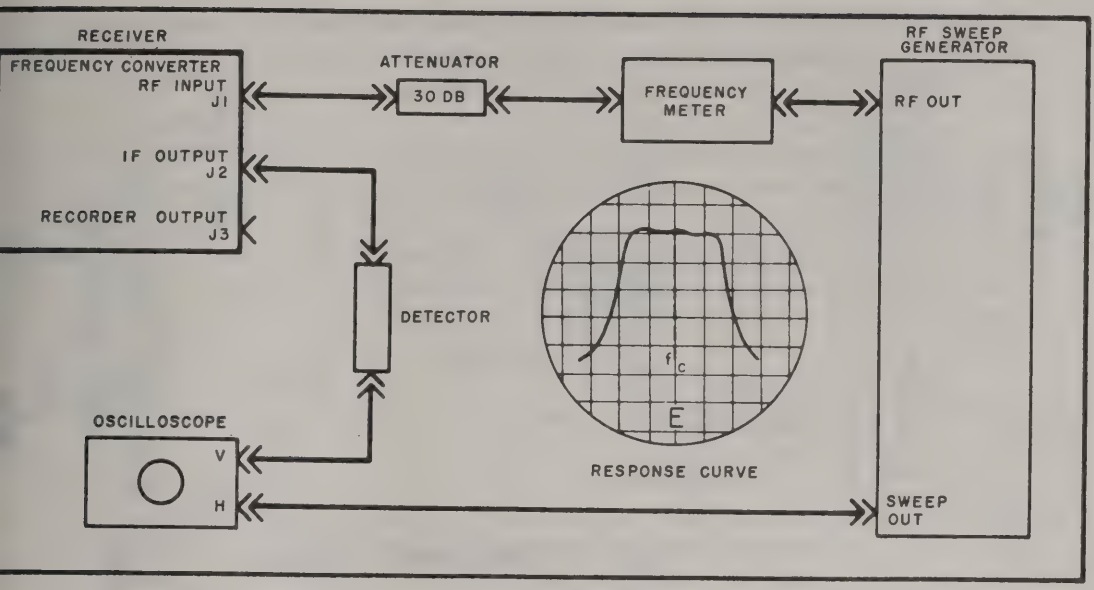


Figure 4-38. Frequency Converter Test and Adjustment

(3) Set FUNCTION SELECTOR switch S1 on the Frequency Converter to position 1.

(4) Check for a substantially flat bandwidth of 18 ±3 MHz at the 1-db points, symmetrical about the center frequency f_o.

(5) If the bandwidth is narrow or the response is non-symmetrical about the center frequency, then the following adjustment should be made:

(a) Check the Converter Preselector for proper frequency of operation. (Refer to Converter-Preselector alignment procedure in paragraph G-3.

(b) Unlock the controls and readjust MIXER TUNING ADJ control, RF INPUT ADJUST control and COARSE ADJUST capacitor C1 on the Mixer Cavity (refer to figure 4-39).

(c) If the crystal current reading cannot be maintained within the blue band limit on the STATUS INDICATOR meter M1, then readjust OSC PRESELECTOR OUTPUT ADJUST slider in conjunction with the OSC PRESEL ADJUST control for a blue band limit indication on STATUS INDICATOR meter M1.

(d) Repeat steps (a) and (b) until an optimum condition is obtained.

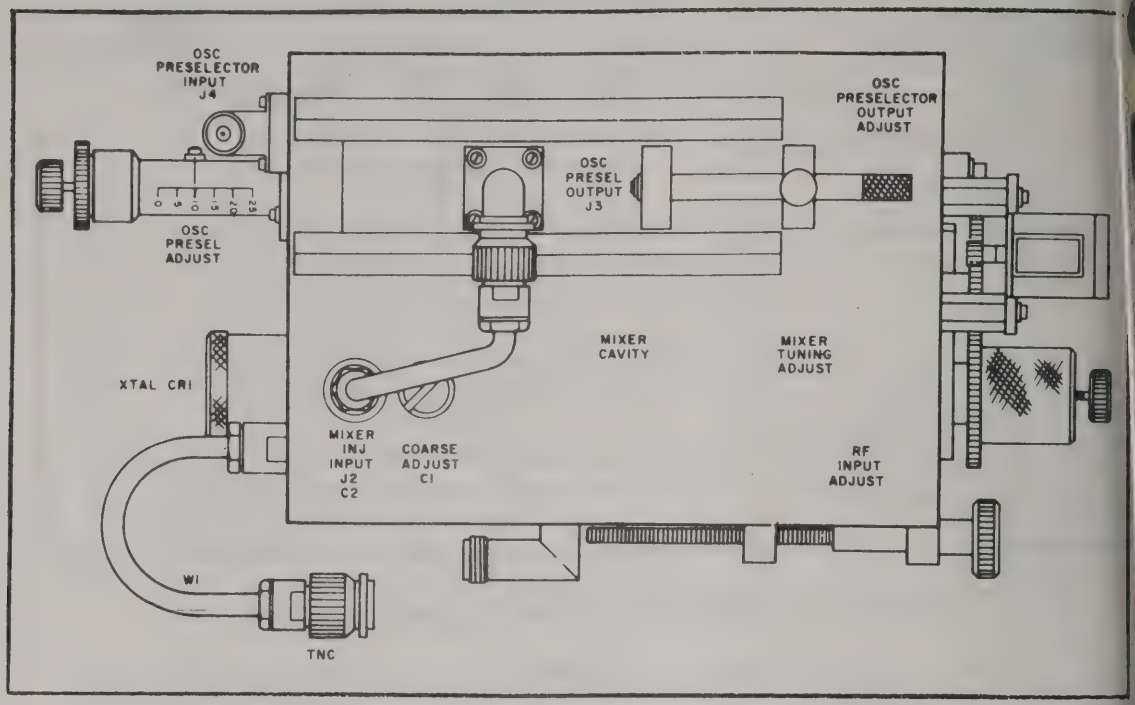


Figure 4-39. Mixer Cavity Controls

(e) If the crystal current reading cannot be maintained within the blue band limit of STATUS INDICATOR meter M1, then refer to step o of paragraph H-3.

NOTE: Care should be taken when adjusting COARSE ADJUST control C1 on Mixer Cavity as this is a coarse adjustment and has a substantial effect on the overall response. It also is necessary to maintain the crystal current within the blue band limit of the Status Indicator Meter, (with the Function Selector switch in position 1), when adjustments in step (b) are made.

(f) If bandwidth or symmetry still does not meet specifications, then readjust capacitors C11, C12, C26 of the IF Preamplifier as indicated in Preamplifier alignment procedure step f of paragraph H-3. In this manual, paying particular attention to the response being displayed on the Oscilloscope. A response as indicated in figure 4-38 is desirable.

CAUTION: Caution should be employed when adjusting C26 of IF Preamplifier since over-adjustment of this neutralizing capacitor may cause oscillations.

(g) If bandwidth or symmetry still does not meet specifications, then a complete realignment of the Mixer-Preamplifier as indicated in paragraph H-3 of this manual will be necessary.

(6) If the bandwidth and symmetry specifications are satisfactory but the response is tilted, then the following adjustments should be made:

(a) Carefully adjust the MIXER TUNING ADJUST control on the mixer cavity (refer to figure 4-39). If this adjustment does not flatten the response, then return the adjustment to its original setting as indicated on the counter dial.

(b) Readjust inductor L4 on the IF Preamplifier until a level response is observed.

(c) If the response is still tilted then realign the Mixer-Preamplifier as described in paragraph H-3.

b. Gain Measurement

(1) Connect the equipment as in figure 4-40 (Mixer-Preamplifier Measurement).

(2) Using the Frequency Meter, set the Signal Generator for the carrier frequency f_o at the same nominal output power level at the output of the 30-db Attenuator as indicated in paragraph a, step (2).

(3) The gain of the Frequency Converter should be 26-32 db for a satisfactory response.

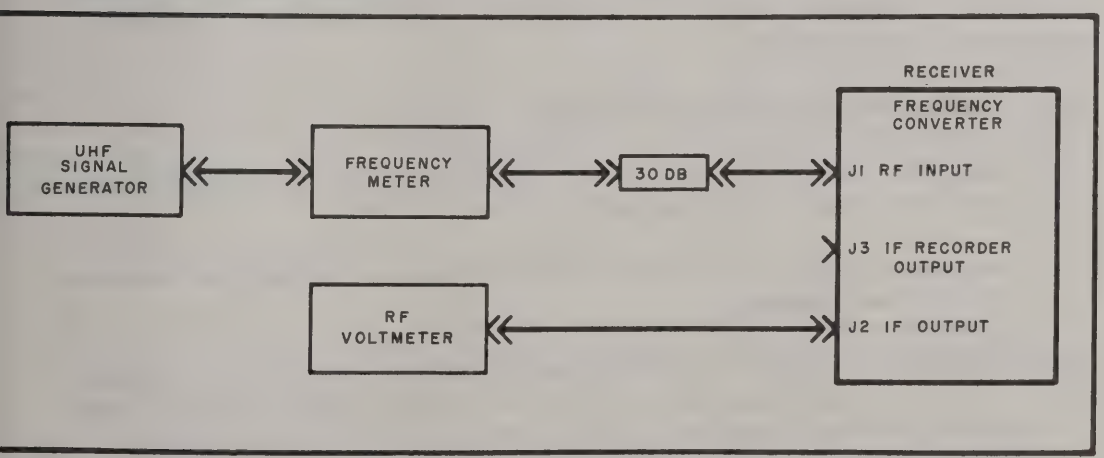


Figure 4-40. Mixer Preamplifier Measurement

(4) If the gain specifications step (3) are not met, the following adjustments should be made:

(a) Replace Mixer diode in Mixer cavity. (Refer to figure 4-39.)

(b) If the gain is still out of specification, perform steps (1) and (6) of paragraph a of this procedure with emphasis on obtaining proper gain while maintaining the required response.

(5) Remove test equipment and restore all cables for normal operation.

c. Residual Noise Measurement

(1) With the Receiver connected for normal operation, connect an RF Voltmeter to the IF Amplifier (2) output. When the Frequency Converter is properly aligned, a level of approximately 2.5 mv or less, of residual noise will be indicated by the RF Voltmeter.

(2) If more than 3 millivolts of residual noise is present, then refer to paragraph H-3, step r, Mixer-Preamplifier alignment procedure and/or paragraph M1 for the Tunnel Diode Amplifier.

d. Lock all the locking devices on the Mixer while observing that the performance requirements are not changed.

3. Converter-Preselector Alignment

The purpose of this procedure is to align the Converter-Preselector when the overall gain or bandwidth of the Frequency Converter cannot be met. (It should be noted that Converter-Preselector tuning control Z1 must be repeated when connected to Mixer.) A Directional Coupler, Microwave Power Meter with Thermistor Mount, Sweep Generator, Frequency Meter, Oscilloscope, 50-ohm Termination and Detector are required for this procedure.

a. Connect the test equipment as shown in figure 4-41.

b. Using the Frequency Meter set the Sweep Generator for a center frequency corresponding to the receiving RF carrier frequency.

c. Set the Frequency Meter for the frequency corresponding to the receiving RF carrier frequency.

d. Measure the 1-db bandwidth by changing the frequency of the Frequency Meter above and below the receiving RF carrier frequency (step c) until the Microwave Power Meter drops 1 db. The 1-db points should be symmetrical about the receiving frequency, and a minimum of 20 mc.

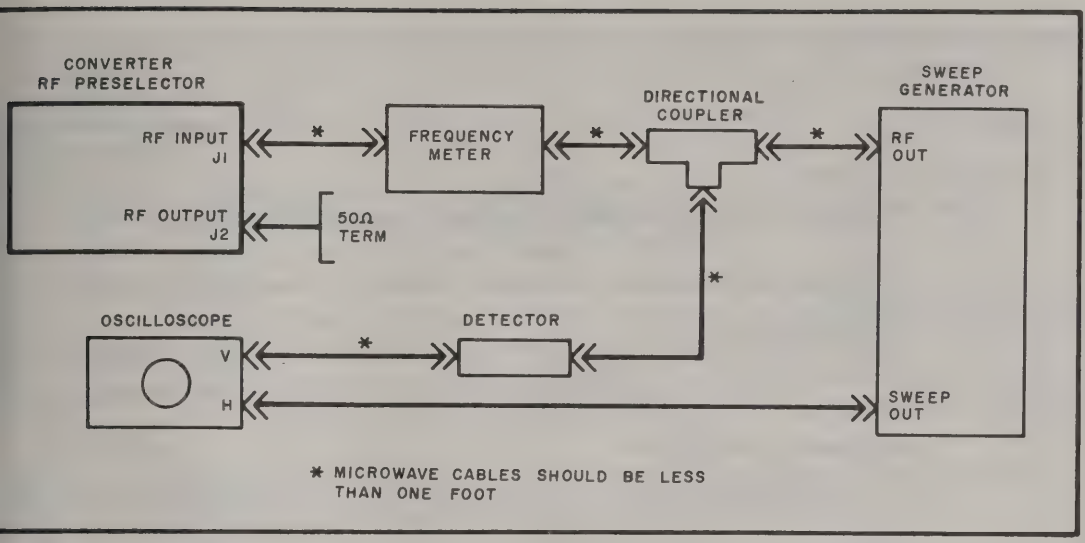


Figure 4-41. Converter-Preselector Alignment

e. Measure the 3-db bandwidth as in step d. The 3-db points should be symmetrical about the receiving frequency and a minimum of 70 mc.

f. If the requirements of steps d and e are not met adjust tuning control Z1 for an Oscilloscope display which is symmetrical about the marker.

g. When all requirements have been met, remove all test equipment and restore all cables for normal operation.

IF Preamplifier Measurement and Alignment

The purpose of this procedure is to measure the bandwidth and gain of the Preamplifier, and realign if necessary, when the requirement for the Frequency nverter Gain and Bandwidth cannot be met. This procedure determines that the nsistors and tuned circuits are operating normally. If the IF Preamplifier oscil- es, it is simply an indication that C26 is misadjusted. Final adjustments are made conjunction with the Mixer Alignment Procedure. A VHF Sweep Generator, Oscil- cope, Frequency Converter, VHF Signal Generator, RF Voltmeter, and a 20 db enuator are required for this procedure.

a. Connect the equipment as shown in figure 4-42.

b. Adjust the Oscilloscope sensitivity to provide a response presentation of 4 to 6 cm. If no response can be obtained, replace IF Preamplifier module and recheck performance.

c. Tune the Signal Generator to 70 mc. Note position of marker appearing on the Oscilloscope display.

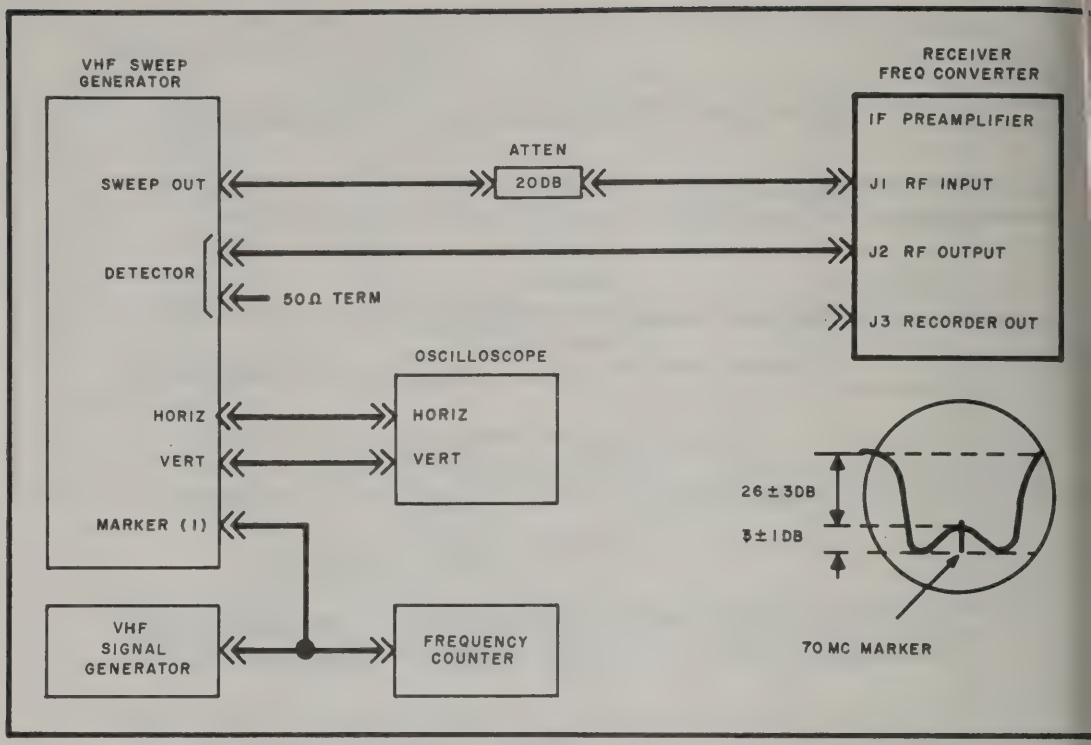


Figure 4-42. IF Preamplifier Bandwidth Measurement

d. Adjust the center frequency control on the Sweep Generator to align the 70 mc marker, appearing on the waveform, with the center of the Oscilloscope. Then, detune the marker.

e. A symmetrical response, similar to waveform on figure 4-42, should be observed.

NOTE: The response observed and the gain measured are only relative; since the IF Preamplifier is noise matched (i.e., impedance matched for optimum noise figure) to a higher mixer output impedance rather than power matched to the lower (50Ω) impedance of the test equipment. The result is the appearance of an over coupled 3 db ±1 db peak to valley response when the amplifier is driven by a 50Ω source impedance Sweep Generator.

f. If a symmetrical response is not observed then the following adjustments should be made:

(1) If the lower frequency portion of the response is distorted then tune the Signal Generator marker to 60 mc and adjust C11 to bring the lower frequency band edge to the marker position.

(2) If the higher frequency portion of the response is distorted then tune the Signal Generator marker to 80 mc and adjust C12 to bring the upper frequency band edge to the marker position.

(3) If the upper frequency band edge has more amplitude than the lower frequency band edge then adjust capacitor C26, a neutralizing capacitor, to obtain amplitude symmetry.

NOTE: Over-adjustment of C26 can cause oscillations in the amplifier. Therefore care should be taken when adjusting this capacitor. This neutralizing capacitor C26 may have to be readjusted when the Mixer and Preamplifier are finally adjusted together.

(4) If the observed response is symmetrical but tilted then adjust L4 inductor to obtain a level peak-to-valley response.

(5) If a symmetrical response cannot be obtained or the amplifier oscillates continually, even after readjusting C26 and all the other adjustments have been performed, then replace the IF Preamplifier module and recheck the performance.

g. Measure the peak-to-peak bandwidth by tuning the Signal Generator marker to the band edges. The requirement is 18 mc minimum. If this requirement is not being met, then readjust C11 and C12 as indicated in step f.

h. Disconnect the test cable from IF OUTPUT connector J2 and reconnect it to RECORDER OUTPUT connector J3. Measure the peak-to-peak bandwidth as in step g above for the recorder output. The bandwidth should be at least 15 mc at the 3-db points.

i. Connect the equipment as shown in figure 4-43 to prepare for a gain measurement.

j. Set the Signal Generator to 70 mc with an output power level of -50 dbm ±5 db measured after the 20-db Attenuator (i.e., set Generator to -30 dbm ±5 db).

k. Measure the relative gain at IF output connector J2 of the IF Preamplifier. The requirement is 23 to 29 db.

l. Connect the RF Voltmeter to recorder output connector J3 on the IF Preamplifier and measure the gain. The requirement is 10 to 16 db.

m. If the gain requirement of steps k and l is not met, then readjust C11, C12 and C26 as indicated in step f. If the gain requirement is still not met then replace the IF Preamplifier module.

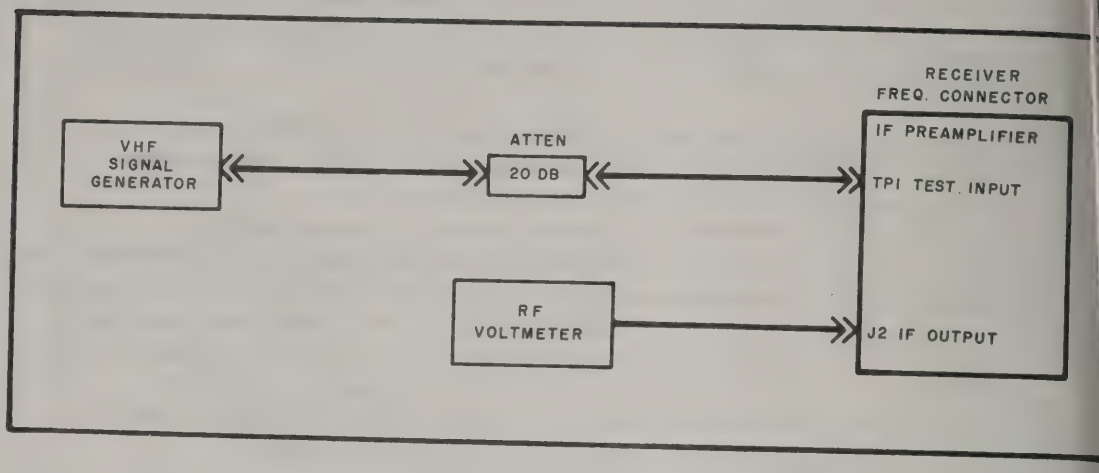


Figure 4-43. IF Preamplifier Gain Measurement

5. IF Preamplifier VSWR Measurement and Adjustment

The purpose of this procedure is to check, and adjust if necessary, the VSWR of the IF Preamplifier after the Mixer Cavity and IF Preamplifier have been properly aligned. A VHF Sweep Generator, VHF Signal Generator, Frequency Counter, Oscilloscope, VSWR Detector, and a 20-db Attenuator are required for this procedure.

a. Connect the equipment as shown in figure 4-44 with the 1.25:1 VSWR reference connected to the VSWR Detector.

b. Adjust the Oscilloscope sensitivity control to provide at least 2 cm of separation between the standard reference line and the 1.25:1 VSWR reference line (refer to figure 4-44).

c. Set the Signal Generator for 70-mc marker frequency and the Sweep Generator for 70-mc center frequency and calibrate the Oscilloscope 70 mc ±3 mc.

d. Remove the 1.25 VSWR reference and connect J2, the IF output of the Preamplifier to the VSWR reference port of the VSWR Detector.

e. The IF output VSWR reference line should appear within the 2 cm separation area over 70 mc ±3 mc minimum.

f. If the IF output VSWR reference line falls outside the 2 cm separation limit, then adjust output transformer T2 for optimum VSWR.

NOTE: Even though the IF output VSWR specifications are 1.25:1 over ±3 mc for 72 and 132 channel operation a VSWR of up to 1.5:1 is acceptable.

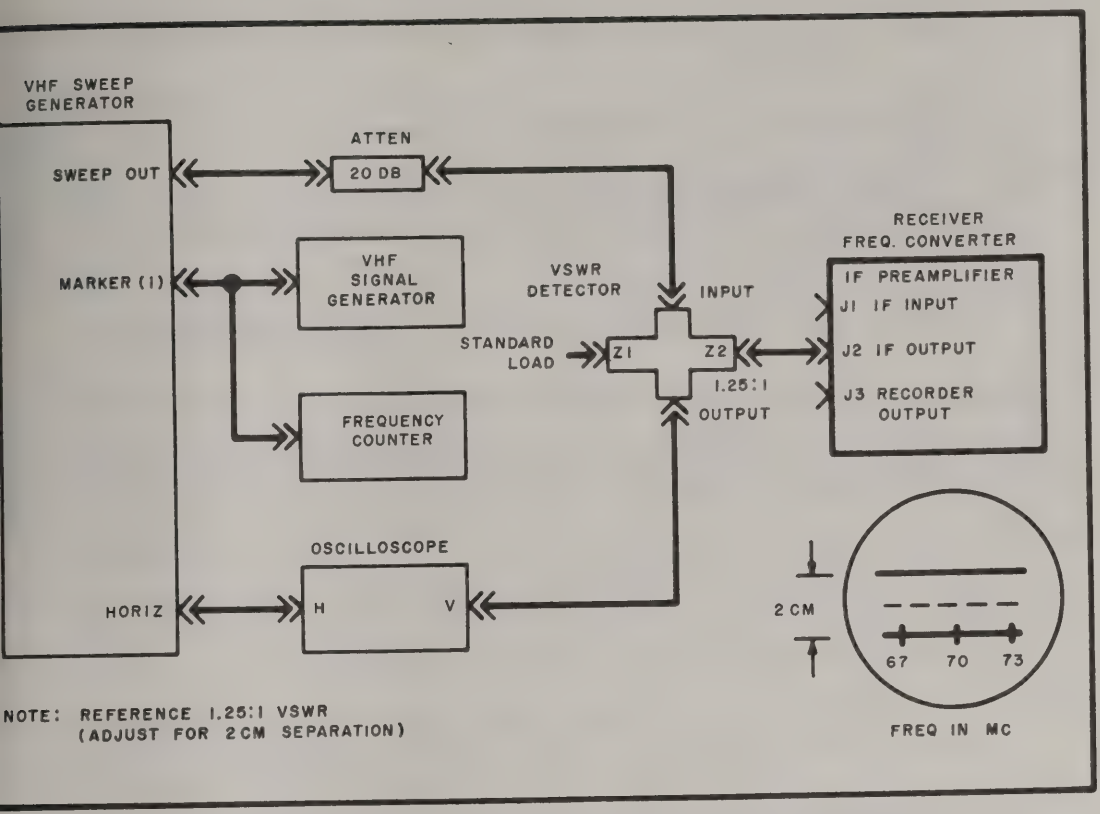


Figure 4-44. IF Preamplifier VSWR Measurements

g. Repeat steps a through e for the IF Recorder Output VSWR at connector J3.

h. If the IF Recorder output VSWR reference line falls outside the 2 cm separation limit, then adjust recorder amplifier output transformer T3 for optimum VSWR.

Panel-Meter Calibration

The purpose of this procedure is to calibrate the front-panel meter on the requency Converter when the requirements of the performance test are not met. djustments are made on the Monitor Control Module, just inside the front panel of the rawer. No special test equipment is required.

OTE: Any meter calibration adjustments are made only after the stage affected by the monitoring has been checked and found to be operating properly.

a. Turn FUNCTION SELECTOR SWITCH S1 to position 9 SPARE and if necessary, zero (mechanically) the pointer on the meter scale.

NOTE: Only those positions requiring calibration are recognized in this procedure.

b. Turn FUNCTION SELECTOR switch S1 to position 6.

c. The STATUS INDICATOR meter should indicate in the red color limit band. If the requirement is not met, refer to paragraph G-1c.

d. If the requirement of paragraph G-1c is met, adjust SRD MULT OUT potentiometer R2 for an indication in the red color limit band.

e. Turn FUNCTION SELECTOR switch S1 to position 7.

f. The STATUS INDICATOR meter should indicate in the red color limit band. If the requirement is not met, refer to paragraph G-1b.

g. If the requirement of paragraph G-1b is met, adjust LF AMPL OUT potentiometer R4 for an indication in the red color limit band.

h. Turn FUNCTION SELECTOR switch S1 to position 8.

i. The STATUS INDICATOR meter should indicate in the red color limit band. If the requirement is not met, refer to paragraph G-1a.

j. If the requirement of paragraph G-1a is met, adjust OSC DBLR OUT potentiometer R5 for an indication in the red color limit band.

k. Turn FUNCTION SELECTOR switch S1 to position 12. Connect the test probe (red) to TP2 on the Monitor Control.

l. The STATUS INDICATOR meter should indicate in the red color limit band. If the requirement is not met, refer to paragraph G-1c.

m. If the requirement of paragraph G-1c is met, adjust SRD MULT BIAS potentiometer R6 for an indication in the red color limit band.

. RECEIVER EQUIPMENT ALIGNMENT PROCEDURE FOR FREQUENCY CHANGE ONLY

This alignment procedure is performed when the Receiver frequency is hanged. It is rather lengthy and detailed. Please be patient in carrying out all eps since it will assure not only a stable local oscillator performance but will allow certain variation of optimum drives due to aging, etc. All test and alignment pro-edures are performed with the equipment out of service. See figure 4-1 for the ocation of the individual components in the Frequency Converter drawer.

Injection Chain Alignment

The purpose of this procedure is to set the frequency of the local oscillator jection chain when the frequency of the Receiver is changed. A Frequency Counter ith a converter which covers 45 to 60 mc, a Frequency Meter, a Microwave Power eter with a Thermistor Mount, a 30-db RF Attenuator, a 10-db RF Attenuator a -db RF Attenuator, a Multimeter and a DC VTVM are required for these procedures.

OTE: For all measurements, set the Range Selector of the Microwave Power Meter to the highest range. Ascertain that the low range scales are zeroed properly before use.

a. Oscillator-Doubler Alignment

NOTE: Unless otherwise noted, all controls and connectors used when performing the following procedure are located on the Oscillator-Doubler module.

(1) Determine the injection and crystal frequencies of the newly assigned carrier frequency as follows:

(a) For Carrier Frequency (F_C) = 1700 to 1960 mc

$$\text{Crystal Frequency } (F_X) = \frac{(F_C \pm 70)}{34} \text{ mc}$$

Except where the dividend ($F_C \pm 70$) is 1730 to 1836 mc, then the divisor is 36.

(b) For Carrier Frequency (F_C) = 1960 to 2100 mc

$$\text{Crystal Frequency } (F_X) = \frac{(F_C - 70)}{34} \text{ mc}$$

or

$$\text{Crystal Frequency } (F_X) = \frac{(F_C + 70)}{42} \text{ mc}$$

Except where the dividend ($F_C + 70$) is 2140 to 2170 mc, then the divisor is 38.

(c) For Carrier Frequency (F_C) = 2100 to 2400 mc

$$\text{Crystal Frequency } (F_X) = \frac{(F_C \pm 70)}{42} \text{ mc}$$

Except where the dividend ($F_C \pm 70$) is 2170 to 2268 mc then the divisor is 38.

(2) Remove the existing crystal and insert a new crystal of the proper frequency, using the procedure specified in paragraph K-3.

(3) After waiting 5 to 10 minutes, check that the crystal oven temperature has stabilized. This may be verified by observing that the crystal oven heater indicator DS1 on the Frequency Converter Drawer is cycling on and off.

(4) Connect a Microwave Power Meter through a Type N female to Micon female adapter to RF OUTPUT connector J2.

(5) Connect a Frequency Counter to RF MON connector J1.

(6) Set FREQ VER capacitor C5 to the mechanical center position, (approximately 5 turns in the clockwise direction from minimum capacity setting).

(7) Tune FREQ ADJ capacitor C6 and OUTPUT ADJ capacitor C12 for a peak indication on the Microwave Power Meter. The indication should be between 2 and 5 mw.

(8) If necessary, reset FREQ VER capacitor C5 for an indication on the Frequency Counter within ±200 cps of the frequency marked on the crystal. The setting of capacitor C5 should occur within 1 db of the peak power output obtained in step (7).

(9) If necessary, readjust OUTPUT ADJ capacitor C12 for a peak power indication on the Microwave Power Meter between 2 and 5 mw.

NOTE: If an adjustment of capacitor C12 is required, recheck the crystal frequency at connector J1.

(10) If the Oscillator-Doubler performance standards cannot be met, the crystal, and if necessary, the entire unit should be replaced with a spare unit and the defective module repaired.

(11) Remove all test equipment and reconnect the Oscillator-Doubler for normal operation.

(12) Set FUNCTION SELECTOR switch S1 on the Frequency Counter to position 8 and, if necessary, adjust potentiometer R5 on the Monitor Control (figure 4-1) for an indication with the red color band on STATUS INDICATOR meter M1.

b. LF Amplifier Alignment

NOTE: Unless otherwise specified, all controls and connectors used, when performing the following procedure, are located on the LF Amplifier.

CAUTION: Remove the Pilot Interlock cable from Pilot Reflex connector CP3. This protects the diodes in the Pilot Amplifier when the Power Supply voltages are turned off. Do not reconnect this cable until the alignment of the entire injection string alignment has been completed.

(1) Set circuit breakers CB3 and CB4 on the Power Supply-Blower to OFF. This removes the power supply voltages to the LF Amplifier.

(2) Connect the Microwave Power Meter through a 30-db RF Attenuator to the output of Attenuator AT1.

(3) Set the range switch on the Microwave Power Meter to the 1 milliwatt position.

(4) Set circuit breakers CB3 and CB4 on the Power Supply-Blower to ON.

(5) Adjust the variable capacitors, in the sequency given in the following listing, for a peak indication on a DC VTVM connected between the specified TEST jack and GRD jack TP1.

Capacitor	Test Jack	Requirement
INPUT C5	AMPL (1) TEST TP2	-0.5 vdc min
INTERSTAGE C18	AMPL (2) TEST TP3	-0.1 vdc min
OUTPUT C26	AMPL (3) TEST TP5	-0.5 vdc min

(6) Readjust INPUT capacitor C5, INTERSTAGE capacitor C18 and OUTPUT capacitor C26 for maximum power indication on the Microwave Power Meter.

(7) Reset GAIN ADJ potentiometer R15 for a 0.42 mw indication on the Microwave Power Meter (corresponding to 420 mw output). Repeat step (6).

(8) If the LF Amplifier output power requirement of 420 mw cannot be met, although the performance standards given in paragraph H-1a are satisfied, the LF Amplifier should be replaced with a spare unit and the defective module repaired.

(9) Connect a multimeter to TP5 of the LF Amplifier. Observe the voltage reading on the multimeter. This voltage will be used as a reference for the alignment of the SRD multiplier in paragraph H-1c.

(10) Set circuit breakers CB3 and CB4 on the Power Supply-Blower to OFF.

(11) Remove all test equipment and reconnect cable W2 to Attenuator AT1 for normal operation.

(12) Set circuit breakers CB3 and CB4 on the Power Supply-Blower to ON.

(13) Set FUNCTION SELECTOR switch S1 on the Frequency Converter to position 7 and, if necessary, adjust potentiometer R4 on the Monitor Control (figure 4-1), for an indication within the red color band on STATUS INDICATOR meter M1.

c. SRD Multiplier Alignment

NOTE: Unless otherwise noted, all controls and connectors used, when performing the following procedure, are located on the SRD Multiplier.

(1) Set circuit breakers CB3 and CB4 on the Power Supply-Blower to OFF.

(2) Connect the equipment as shown in figure 4-37.

(3) Set the Range Selector switch on the Microwave Power Meter to the 10-mw scale. When power supply voltage is restored, reset the Range switch as required.

(4) Set the Frequency Meter to about 50 mc above or below the SRD Multiplier output frequency.

NOTE: The SRD Multiplier output frequency is plus or minus 70 mc off the Receiver carrier frequency. The SRD Multiplier multiplication factor is 17, 18, 19, or 21, depending on the carrier frequency.

(5) Set circuit breakers CB3 and CB4 on the Power Supply-Blower to ON.

(6) Set cavity tuning controls Z1 and Z2 to the maximum clockwise direction.

(7) Adjust RF output tuning control C6 by rotating RF output connector J2 to the fully counterclockwise position (maximum coupling). Back off 2.5 turns in the clockwise direction.

(8) Set bias potentiometer R1 to the fully clockwise position; then back off 3 turns in the counterclockwise direction.

(9) Adjust pi-network capacitor C2 for a maximum bias indication on the DC VTVM connected to TP2 of the Monitor Control.

(10) Simultaneously adjust cavity tuning controls Z1 and Z2 in a counterclockwise direction for a maximum RF power output on the Microwave Power Meter. Optimize reading by slightly retuning controls Z1 and Z2 independently.

(11) Scan the output with the Frequency Meter to establish the approximate frequency to which the SRD Multiplier is tuned.

(12) Resume the simultaneous tuning of cavities Z1 and Z2 until the required injection frequency is reached.

(13) Slightly retune cavities Z1 and Z2 independently for a maximum RF output on the Microwave Power Meter.

NOTE: From this point onwards, make frequent checks with the Frequency Meter to insure that the SRD Multiplier is still operating at the required injection output frequency.

(14) Adjust bias control R1 (normally in a counterclockwise direction) for a maximum reading on the Microwave Power Meter.

(15) In small increments, adjust pi-network capacitor C2, starting from a fully clockwise to a fully counterclockwise position, in each case searching for a maximum power output in conjunction with a stable (no sharp peaks) condition of operation.

NOTE: Several maximum RF power output settings may be obtained when tuning pi-network capacitor C2. The optimum setting may be such that the power output will plateau rather than go through a sharp peak. At the same time the voltage indication on the Multimeter connected to TP5 of the LF Amplifier should compare closely to the level observed in paragraph b, step (9) when the LF Amplifier was terminated in 50 ohms.

(16) Adjust RF output coupling capacitor C6 (by rotating RF output connector J2) in conjunction with cavity tuning control Z2 for a maximum power output indication on the Microwave Power Meter.

(17) Slightly readjust Z1 and Z2 for maximum power output.

(18) Observe that the bias voltage at TP2 of the Monitor Control is between -0.5 and -2.5 volts dc.

(19) Rotate the RF output coupling capacitor C6 at connector J2 to determin the direction in which the power output as observed on the Microwave Power Meter decreases smoothly. The final setting of the output coupling capacitor C6 must be at a point where the power output is at least between 0.3-db and 0.5-db below the maximum output power in the smoothly decreasing direction.

(20) Measure the output power on the Microwave Power Meter as connected in figure 4-37. It should be between 2.5 and 4 mw (corresponding to a 25 mw to 40 mw output level of the SRD Multiplier output before the 10-db pad).

(21) Set the frequency meter to the SRD Multiplier output frequency, and observe that a dip of 2-db or greater is obtained on the Microwave Power Meter.

(22) Continue to tune the frequency meter ±70 mc above and below the SRD Multiplier output frequency, and observe that no other dip (except that of the output frequency) is obtained. This signifies the absence of spurious frequency outputs.

(23) Set the blower circuit breaker CB2 on the Power Supply-Blower to OFF.

(24) Restore power, instantaneously, by setting circuit breaker CB2 on the Power Supply-Blower to ON, and check that the SRD Multiplier power output returns immediately to its original condition as observed in step (20). This signifies that the SRD Multiplier is operating in a stable condition.

(25) Repeat steps (23) and (24) but wait 10 seconds between shut off and application of power supply voltages.

(26) Locate and unlock GAIN ADJ potentiometer R15 on the LF Amplifier.

(27) Set the circuit breakers CB3 and CB4 on the Power Supply-Blower to OFF.

NOTE: The following steps (28 through 43) are tests to establish the dynamic range of the SRD Multiplier. These test establish that the SRD will operate with both higher and lower levels than outlined in the procedure.

(28) Connect the Microwave Power Meter, through a 30-db RF Power Attenuator, to the output of 3-db Attenuator AT1 (normally connected to the output connector J2 of the LF Amplifier).

(29) Set the range switch on the Microwave Power Meter to the 1 mw scale.

(30) Set circuit breakers CB3 and CB4 on the Power Supply-Blower to ON.

(31) Adjust GAIN ADJ potentiometer R15, on the LF Amplifier, for a power output level of 530 mw (0.53 mw on the Microwave Power Meter) which is 1-db above the LF Amplifier output level, observed in paragraph b, step (7).

(32) Set circuit breakers CB3 and CB4 on the Power Supply-Blower to OFF.

(33) Reconnect Attenuator AT1 to cable W2.

(34) Observe that the power output level is within approximately ±1-db of the SRD Multiplier output level observed in step (20).

(35) Set circuit breakers CB3 and CB4 on Power Supply-Blower to OFF.

(36) Connect a 3-db RF Attenuator between plug P3 of cable W2 and 3-db Attenuator AT1 (normally connected to output connector J2 of the LF Amplifier).

(37) Set circuit breakers CB3 and CB4 on the Power Supply-Blower to ON.

(38) Observe that the power output level is approximately 2 to 3 db below the SRD Multiplier output level observed in step (20).

(39) Repeat steps (21) through (25).

(40) Steps (31) through (39) are performed to check the stability of the SRD Multiplier operation.

(41) Set circuit breakers CB3 and CB4 on the Power Supply-Blower to OFF.

(42) Remove the 3-db RF Attenuator, inserted in step (36).

(43) Connect the Microwave Power Meter, through a 30-db RF Power Attenuator, to the output of 3-db Attenuator AT1.

(44) Set the range switch on the Microwave Power Meter to the 1-mw scale.

(45) Set circuit breakers CB3 and CB4 on the Power Supply-Blower to ON.

(46) Adjust GAIN ADJ potentiometer R15 on the LF Amplifier for the same level as paragraph b, step (7); 0.42 mw on the Microwave Power Meter (corresponding to 420 mw output level).

(47) Set circuit breakers CB3 and CB4 on the Power Supply-Blower to OFF.

(48) Reconnect Attenuator AT1 to cable W2.

(49) Set circuit breakers CB3 and CB4 on the Power Supply-Blower to ON.

(50) Recheck steps (20) through (25).

(51) In case of difficulties; that is, if requirements of steps (20) through (50) cannot be met, proceed as follows. New settings for pi-network capacitor C2 and bias potentiometer R1 may be required as well as a slight readjustment of output coupling capacitor C6 (part of RF output connector J2) in a counterclockwise direction. In addition, the parameters of some diodes may require that bias control R1 be further rotated, in the counterclockwise direction, to a secondary operating point. Finally, if instability persists, an incorrect setting of the input slider is indicated. To correct the input slider setting proceed as follows:

(a) Set the Frequency Meter to approximately 50 mc above or below the SRD Multiplier output frequency.

(b) Very slightly, readjust the input slider, pausing at each small interval to retune Z1 for a peak power indication on the Microwave Power Meter.

(c) In small increments, alternately adjust potentiometer R1 and capacitor C2 for a maximum indication on the Microwave Power Meter.

(d) Observe that the bias voltage at test jack TP2 of the Monitor Control is between -0.5 and -2.5 volts dc.

(e) If necessary, retune output coupling capacitor C6, at output connector J2, in conjunction with tuning control Z2, to obtain maximum power output on the Microwave Power Meter.

(f) Retune Z1 for maximum power output.

(g) Readjust output coupling capacitor C6, at connector J2, to determine the direction in which the power output, as observed on the Microwave Power Meter, decreases smoothly. The final setting of output coupling capacitor C6 should be at a point where the power output is between 0.3-db and 0.5-db below the maximum output power in the smoothly decreasing direction.

(h) Recheck the results specified in steps (19) through (50). These results signify the absence of spurious outputs and that the SRD Multiplier is tuned for stable operation.

(i) If stability is still indicated, set the input slider to the maximum counterclockwise position and in small intervals bring the slider out in the clockwise direction, each time repeating step 51 (c) through (g) until the most stable condition is obtained.

(52) Disconnect the test equipment and restore circuit connections.

(53) On the Frequency Converter, set FUNCTION SELECTOR switch S1 to position 6 and, if necessary, adjust potentiometer R6 on the Monitor Control (figure 4-1), for an indication within the red color band on STATUS INDICATOR meter M1.

2. Converter-Preselector Alignment

The purpose of this procedure is to align the Converter-Preselector when changing the assigned RF carrier frequency of the Frequency Converter. A Directional Coupler, Microwave Power Meter with Thermistor Mount, Sweep Generator, Frequency Meter, Oscilloscope, 50-ohm Termination and Detector are required for this procedure.

a. Connect the test equipment as shown in figure 4-41.

b. Using the Frequency Meter set the Sweep Generator for a center frequency corresponding to the receiving RF carrier frequency.

c. Adjust tuning control Z1 for an Oscilloscope display which is symmetrical about the marker.

d. Set the Frequency Meter for the frequency corresponding to the receiving RF carrier frequency.

e. Measure the 1-db bandwidth by changing the frequency of the Frequency Meter above and below the receiving RF carrier frequency (step d) until the Microwave Power Meter drops 1 db. The 1-db points should be symmetrical about the receiving frequency, and a minimum of 20 mc.

f. Measure the 3-db bandwidth as in step e. The 3-db points should be symmetrical about the receiving frequency and a minimum of 70 mc.

g. When all requirements have been met, remove all test equipment and restore all cables for normal operation.

3. Mixer-Preamplifier Alignment

The purpose of this procedure is to align the Mixer and to make the final adjustments in the IF Preamplifier when the assigned RF frequency of the Frequency Converter is changed. It is essential that the IF Preamplifier (refer to paragraph G-4) and Converter-Preselector (refer to paragraph H-2) are aligned satisfactorily and the front-panel meter has been calibrated before starting this procedure. An Oscilloscope, a Frequency Meter, 30-db Attenuator, Detector, a Microwave Power Meter with Thermistor Mount, a Sweep Generator, and a RF Signal Generator are required for this procedure.

a. Connect the equipment as in figure 4-38.

b. Set the Sweep Generator for operation about the desired RF signal frequency f_o and adjust the Sweep Generator output power to provide a nominal -45 dbm power level at the output of the 30-db Attenuator.

c. Set Frequency Converter FUNCTION SELECTOR switch S1 to position 1.

d. Preset the tuning controls (figure 4-39) as follows:

NOTE: The W6 cable between the Mixer RF Input and Converter Preselector Output (refer to 22761-02 Schematic) depends on the choice of the RF Frequency Band:

In the 1700 to 2050 mc band cable W6 is used. In the 2050 to 2400 mc band cable W6A is used.

(1) Preset the OSC PRESELECTOR ADJUST counter for the proper injection frequency as shown in part A, figure 4-45.

(2) Preset the MIXER TUNING ADJUST counter for the new carrier frequency as shown in part B, figure 4-45.

(3) Preset the RF INPUT ADJUST and COARSE ADJUST C1 controls for the new carrier frequency as shown in figure 4-46, part A and B, respectively.

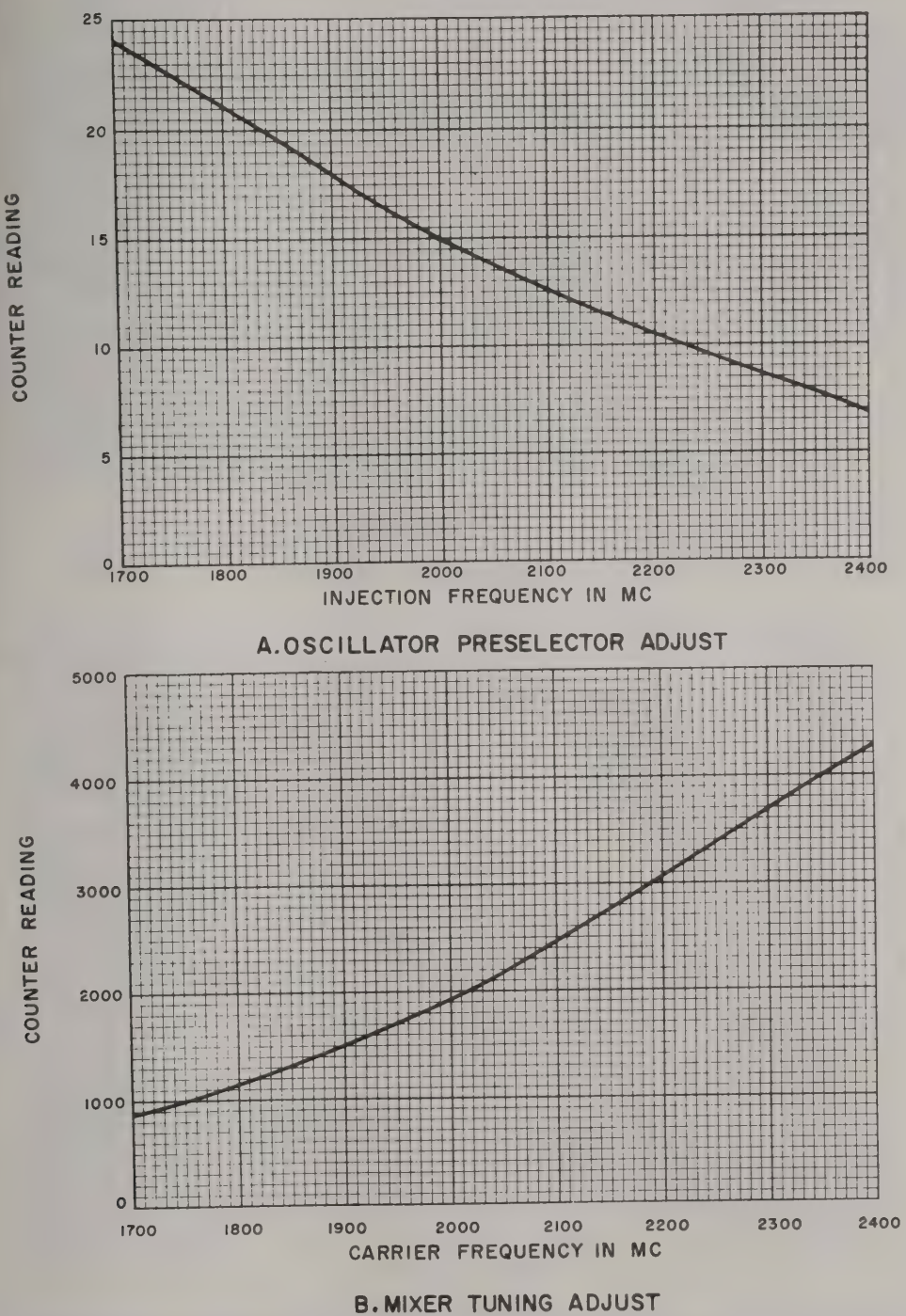


Figure 4-45. Mixer Cavity Counter Settings

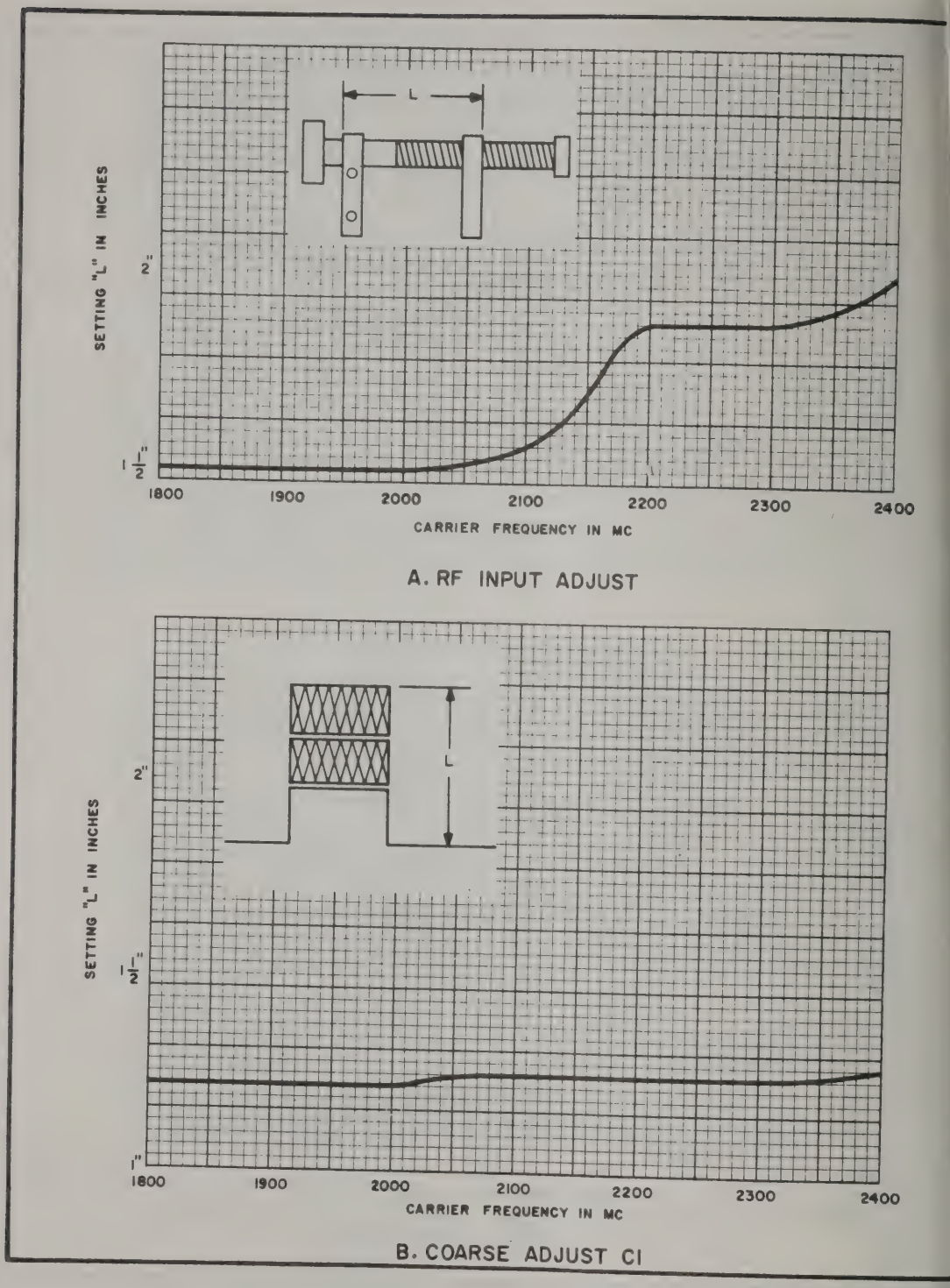


Figure 4-46. Mixer Cavity Control Settings

e. Fine tune OSC PRESELECTOR ADJUST control to obtain a peak crystal current indication on the front panel STATUS INDICATOR meter M1 (in position 1).

f. Alternately adjust OSC PRESELECTOR OUTPUT ADJUST and OSC PRESELECTOR ADJUST controls, until a peak reading is obtained within the blue scale. This step may have to be repeated several times since both OSC Preselector adjustments interact.

g. If a blue scale indication cannot be obtained in step f, repeat steps a through e, making sure that at least 25 mw of power output is present at the output port of the circulator connected to the SRD Multiplier. Please note that the gain, bandwidth, and noise figure depends upon realization of correct DC crystal current.

h. Vary the MIXER TUNING ADJUST control several turns in both directions observing the response on the Oscilloscope. Tune for optimum response as indicated in part A, figure 4-47 (Mixer Cavity Waveforms).

i. Tune the Frequency Meter to the RF operating frequency and note the marker on the response. Adjust the Oscilloscope controls to obtain

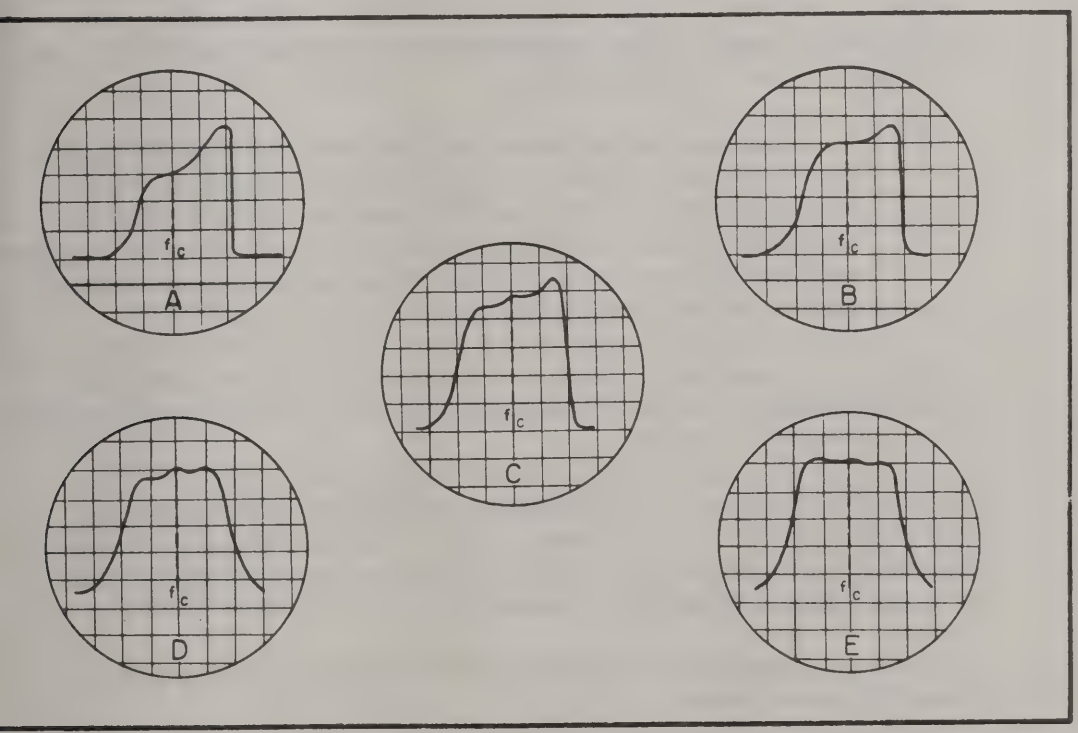


Figure 4-47. Mixer Cavity Waveforms

the f_o marker at the center of the Scope. Observe the symmetry of the response and then detune the marker.

j. Adjust the RF INPUT ADJUST control for an optimum symmetrical response as shown in part B, figure 4-47.

k. Carefully tune COARSE ADJUST capacitor C1 for the flattest symmetrical response as shown in part C, figure 4-47. Use extreme care since the control is coarse and will change the response drastically. Be sure to lock the capacitor tightly after making adjustment.

l. Repeat steps h, j and k until the best possible flat response and symmetry are achieved.

m. If necessary, tune input coil L4 on the IF Preamplifier to eliminate any tilt in the response.

n. Check for a substantially flat bandwidth of 20 ±3 mc at the 1-db points, symmetrical about the center frequency. The gain should be 26-32 db for a satisfactory response (refer to part E, figure 4-47).

o. For optimum performance, a midscale reading (in the blue) should be indicated on the front-panel STATUS INDICATOR meter with selector switch in position 1. If the reading is excessively high or low, then repeat steps e and f. It may also be necessary to repeat steps h, j, and k to maintain the proper response.

NOTE: An indication that the Frequency Converter is properly aligned can be obtained by gently varying either the MIXER TUNING ADJUST or the RF INPUT ADJUST controls. When either is varied individually, a slight ripple will sweep across the response and then the response will return to normal as the adjustment is reset to its original position.

p. Transfer the connection at IF OUTPUT connector J2 to RECORDER OUTPUT connector J3, and then repeat step n. The gain at the Recorder Output should be 21-27 db.

q. Remove the Frequency Converter from the test set-up and connect an RF Voltmeter to IF Output Connector J2. When the Frequency Converter is properly aligned, a level of one millivolt, or less, of residual noise will be indicated by the RF Voltmeter.

r. If more than one millivolt of residual noise is present in step q, two possibilities may exist:

(1) The Preamplifier may be regenerative which is due to improper adjustment of C26. C26 should be adjusted for best symmetrical

bandwidth and best group delay.

(2) High noise output 1 MV or more may be due to a noisy SRD. The remedy to this problem is covered in Appendix B. Please note that a noisy SRD multiplier will also reflect itself as a poor mixer noise figure (15-25 db). Please note that this noise measurement should be made with a Boonton Type 91H VTVM which does not respond to 60 cycles.

Panel-Meter Calibration

The purpose of this procedure is to calibrate the front-panel meter on the equency Converter when the requirements of the performance test are not met. justments are made on the Monitor Control Module, just inside the front panel of drawer. No special test equipment is required.

TE: Any meter calibration adjustments are made only after the stage affected by the monitoring has been checked and found to be operating properly.

a. Turn FUNCTION SELECTOR SWITCH S1 to position 9 SPARE and if necessary, zero (mechanically) the pointer on the meter scale.

NOTE: Only those positions requiring calibration are recognized in this procedure.

b. Turn FUNCTION SELECTOR switch S1 to position 6.

c. The STATUS INDICATOR meter should indicate in the red color limit band. If the requirement is not met, refer to paragraph H-1c.

d. If the requirement of paragraph H-1c is met, adjust SRD MULT OUT potentiometer R2 for an indication in the red color limit band.

e. Turn FUNCTION SELECTOR switch S1 to position 7.

f. The STATUS INDICATOR meter should indicate in the red color limit band. If the requirement is not met, refer to paragraph H-1b.

g. If the requirement of paragraph H-1b is met, adjust LF AMPL OUT potentiometer R4 for an indication in the red color limit band.

h. Turn FUNCTION SELECTOR switch S1 to position 8.

i. The STATUS INDICATOR meter should indicate in the red color limit band. If the requirement is not met, refer to paragraph H-1a.

j. If the requirement of paragraph H-1a is met, adjust OSC DBLR OUT potentiometer R5 for an indication in the red color limit band.

k. Turn FUNCTION SELECTOR switch S1 to position 12. Connect the test probe (red) to TP2 on the Monitor Control.

l. The STATUS INDICATOR meter should indicate in the red color limit band. If the requirement is not met, refer to paragraph H-1c.

m. If the requirement of paragraph H-1c is met, adjust SPD MULT BIAS potentiometer R6 for an indication in the red color limit band.

5. RF Preselector Alignment

The purpose of this procedure is to align the RF Preselector, when the assigned RF carrier frequency is changed.

NOTE: Two alignment procedures are included herein:

(1) A quick alignment procedure entails presetting the resonator tuning controls according to a calibration curve and subsequently optimizing the resonator tunings for a flat top response shape.

(2) An alternate alignment procedure entails the sequential electrical tuning of the five filter resonator. This alternate procedure should be employed when the quick procedures does not provide satisfactory results.

a. Quick Alignment Procedure

A UHF Sweep Generator, Frequency Meter, Directional Coupler, Ferrite Circulator, Oscilloscope Detector, and 50-ohm Termination are required for this procedure.

(1) Connect the test equipment as shown in figure 4-48 with the Directiona Coupler terminated in a 50 ohms load. (Preselector not in setup.)

NOTE: Make sure all test cables have a characteristic impedance of 50 ohms. Microwave cables should be less than one foot and other cables less than six feet long.

(2) Set the Sweep Generator to the assigned operation frequency (center frequency - f_o) of the RF Preselector.

(3) Adjust the Frequency Meter until the marker is observed on this center of the Oscillscope.

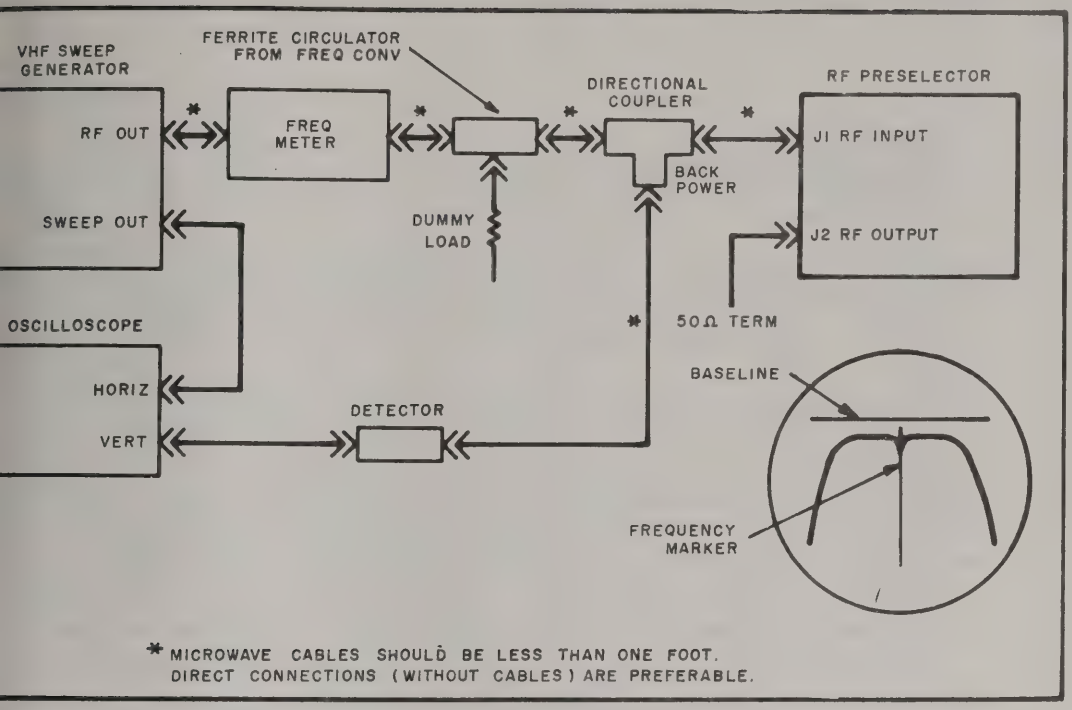


Figure 4-48. RF Preselector Alignment

(4) Preset the Preselector tuning plungers as shown in figure 4-49. The setting should be in the "A" portion on the plunger.

(5) Check the linearity of the Sweep Generator output and adjust it, if necessary.

(6) Connect the equipment as shown in figure 4-48, with the Preselector Input J-1 connected to the Directional Coupler and Preselector Output J-2 connected to the 50-ohm Termination.

(7) Adjust tuning plungers Z1 through Z5 for the flattest response on the Oscilloscope as shown in figure 4-48.

(8) Increase sensitivity of the Oscilloscope and fine-adjust the tuning plungers. Over a frequency range of f_o ±4.0 mc, the response variation should be within 1 centimeter with the Oscilloscope sensitivity set at 1 millivolt/centimeter.

NOTE: Adjusting tuning plungers clockwise will increase the operating frequency. Adjusting tuning plungers counterclockwise will decrease the operating frequency.

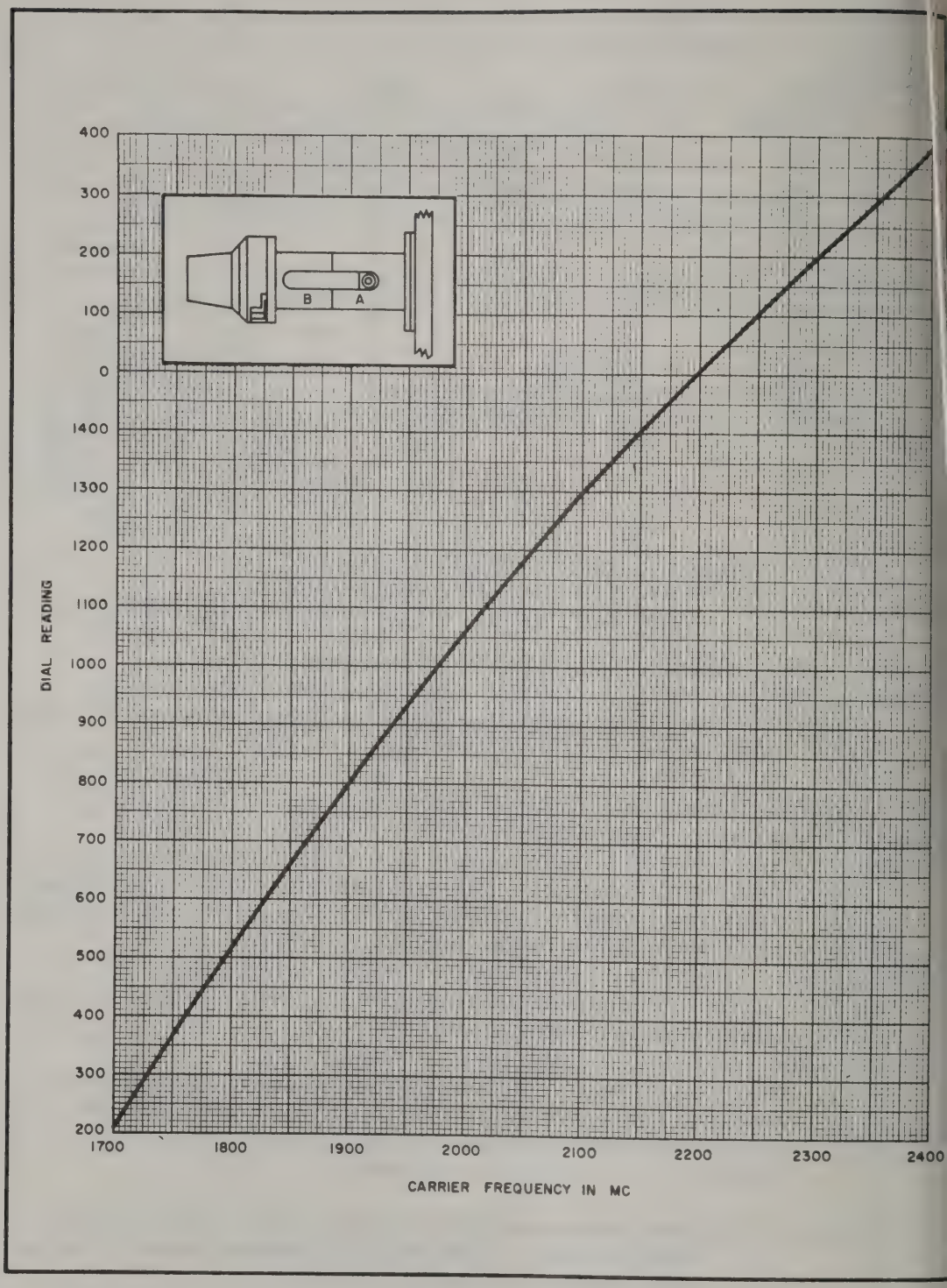


Figure 4-49. RF Preselector Dial Calibration Curve

(9) Watch the Oscilloscope, while locking the tuning controls, to make sure that the RF Preselector is not detuned.

b. Alternate Alignment Procedure

(1) Repeat steps (1), (2) and (3) as per paragraph a (Quick Alignment Procedure).

(2) Turn all resonator tuning plungers counterclockwise to a zero dial reading in the "A" portion on the plungers. This detunes all resonators to the low frequency end of their tuning range.

(3) Check the linearity of the Sweep Generator Output and adjust it, if necessary.

(4) Connect the equipment as shown in figure 4-48 with the Preselector Input J-1 connected to the Directional Coupler and the Preselector Output J-2 connected to the 50-ohm Termination.

(5) Adjust tuning plunger Z1 until a sharply-peaked response curve appears to move across the Oscilloscope presentation.

(6) Continue to adjust Z1 until the marker is centered on the first peak (A, figure 4-50).

NOTE: Adjust tuning plungers clockwise to increase the operating frequency and counterclockwise to decrease the operating frequency.

(7) Adjust tuning plunger Z2 until a second sharply-peaked response curve appears to move across the Oscilloscope presentation.

(8) Continue to adjust Z2 until the marker is centered in the valley between the first and second sharply-peaked responses (B, figure 4-50).

(9) Adjust tuning plunger Z3 until a third sharply-peaked response curve appears to move across the Oscilloscope presentation.

(10) Continue to adjust Z3 until the marker is centered on the peak of the second sharply-peaked response (C, figure 4-50).

(11) Adjust tuning plunger Z4 until a fourth sharply-peaked response curve appears to move across the Oscilloscope presentation.

(12) Continue to adjust Z4 until the marker is centered in the valley between the second and third sharply-peaked responses (D, figure 4-50).

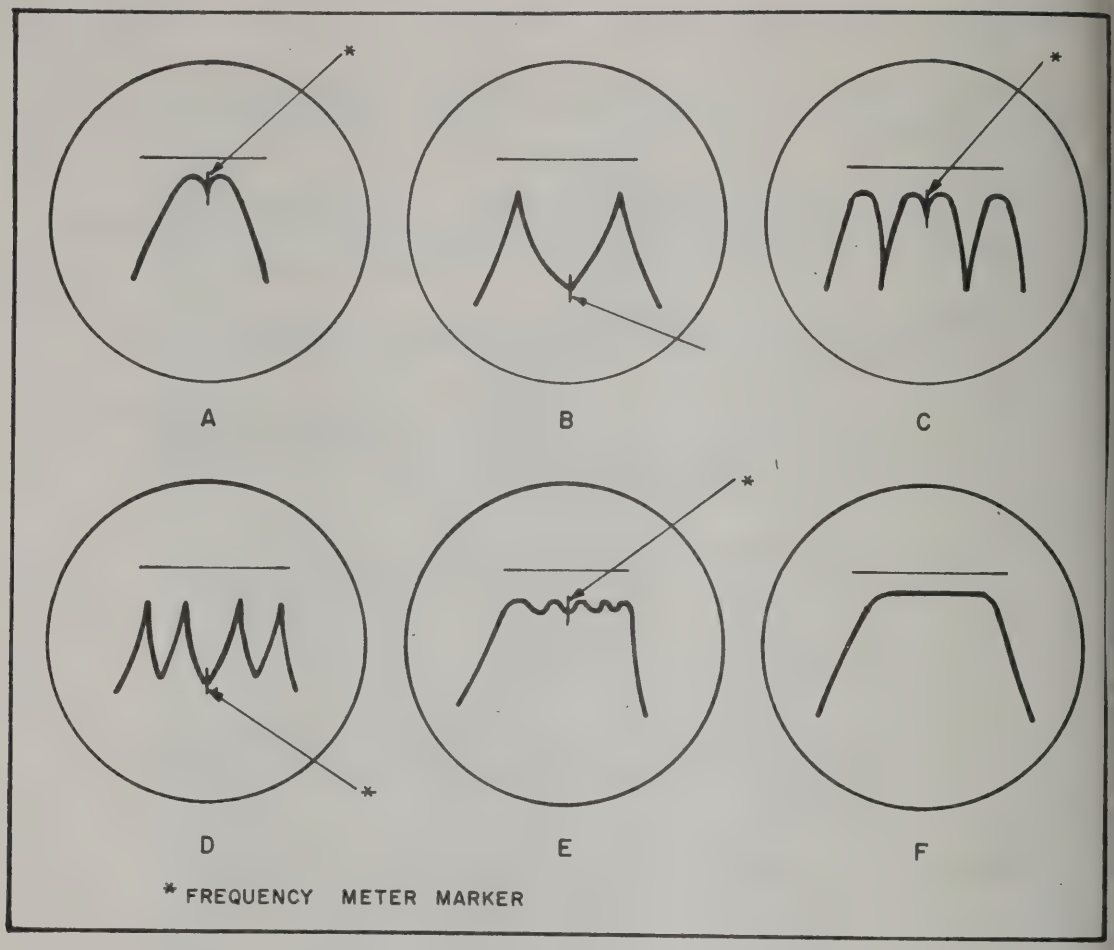


Figure 4-50. RF Preselector Oscilloscope Presentation

(13) Adjust tuning plunger Z5 until the Oscilloscope presentation approximates, as close as possible, the waveform shown in E, figure 4-50.

(14) Detune the Frequency Meter in order to remove the marker from the Oscilloscope presentation.

(15) Narrow the sweep width until the Oscilloscope presentation approximates the waveform shown in F, figure 4-50.

(16) Increase the sensitivity of the Oscilloscope and fine-adjust the tuning plungers to obtain the flattest response on the waveform. Over a frequency range of f_o ±4 mc, the response variation should be within one, with the Oscilloscope sensitivity set at one millivolt per centimeter

(17) Watch the Oscilloscope, while locking the tuning controls, to make sure that the RF Preselector is not detuned.

NOTE: Flatness of response shape can be improved using input/output coupling adjustments L1 and L2. These screw adjustments are factory set to optimize the positions of the input/output coupling loops. It is not recommended that L1 and L2 be readjusted during ordinary field alignments of the RF Preselector.

I. POWER SUPPLY-BLOWER TESTS AND ADJUSTMENTS

1. General

Tests and adjustment procedures are performed when the requirements of a performance test are not met, and the trouble indicated may be due to incorrect alignment and/or adjustment of circuit components. All alignment procedures are performed with the equipment out of service.

NOTE: Overall performance should be checked before proceeding with Power Supply-Blower STATUS INDICATOR meter M1 adjustments.

2. Procedure

The purpose of this procedure is to set the power supply voltages for full loa conditions when the requirements of the performance test are not met and then calibrate the meter switch positions for the correct front-panel meter indications. A well-calibrated DC VTVM and an Oscilloscope are required for this procedure.

NOTE: Unless otherwise specified, all controls used in the following procedure ar located on the Power Supply-Blower.

CAUTION: When the Power Supply-Blower is extended from the Housing, the Air Duct Extension must be installed using the procedure described in paragraph K-6.

a. Connect a well-calibrated DC VTVM to test point TP2; the indication should be +24 volts dc within ±2%.

b. If the indication is more than ±5% of +24 vdc and if in doubt whether it is the voltage or the measuring instrument that is inaccurate, proceed as follows:

(1) Set FUNCTION SELECTOR SWITCH S1 on the Frequency Converter Panel to position 2.

(2) Check that the indication of +24 volts dc as observed on STATUS INDICATOR meter M1 of the Frequency Converter is within the specified green band limit of ±5%.

NOTE: Since the Frequency Converter STATUS INDICATOR meter M1 and shunt resistor R9 across M1 have a total allowable tolerance of ±3%, the indication on the Frequency Converter STATUS INDICATOR meter can be used to verify the existing condition of the power supply voltage.

(3) Set the meter selector switch S2 on the Power Supply-Blower to +24V position.

(4) Measure +24 volts DC on STATUS INDICATOR meter M1 (green line). If there is a slight difference record it for comparison with step (6).

(5) Set the meter selector switch S2 to -24V position.

(6) Measure -24 volts DC on STATUS INDICATOR meter M1 (green line).

(7) Connect the DC VTVM to test point TP3; the indication should be -24 vdc.

(8) Reconnect the DC VTVM to test point TP2.

NOTE: Since the meter calibration control for the +24V and -24V power supplies on STATUS INDICATOR meter M1 is the same, the existing condition of the power supply voltages can again be verified.

c. If necessary, adjust +24V ADJUST potentiometer R3 for precisely +24 vdc as observed on the DC VTVM at test point TP2.

d. Set the meter selector switch S2 to +24V position.

e. If necessary, adjust 24V meter calibration potentiometer R17 for an indication on STATUS INDICATOR meter M1, within the green line limit.

f. Connect a well-calibrated DC VTVM to test point TP3 and measure -24 volts DC within ±2%.

NOTE: If the indication is more than ±5% of -24 vdc and if in doubt whether it is the voltage or the measuring instrument that is inaccurate, proceed as follows:

(1) Set FUNCTION SELECTOR SWITCH S1 on the Frequency Converter to position 3.

(2) Check that the indication of -24 volts dc as observed on STATUS INDICATOR meter M1 of the Frequency Converter is within the specified green band limit of ±5%.

NOTE: Since the Frequency Converter's STATUS INDICATOR meter M1 and shunt resistor R10 across M1 have a total allowable tolerance of ±3%, the indication on the Converter's STATUS INDICATOR meter can be used to verify the existing condition of the power supply voltage.

g. If necessary, adjust -24 volts DC ADJUST potentiometer R14 for precisely -24 volts DC as measured on the DC VTVM at test point TP3.

h. Set meter selector switch S2 to the -24V position.

i. The indication on STATUS INDICATOR meter M1 should be within the green line limit.

NOTE: Do not readjust potentiometer R17, which was adjusted in step e.

j. Connect a well-calibrated DC VTVM to test point TP4 and measure +12 volts DC within ±2%.

NOTE: If the indication is greater than +12 vdc ±5% and there is a doubt whether it is the voltage or the measuring instrument that is inaccurate, proceed as follows:

(1) Set FUNCTION SELECTOR SWITCH S1 on the Frequency Converter Panel to position 4.

(2) Check that the indication of +12 volts dc as observed on STATUS INDICATOR meter M1 of the Frequency Converter is within the specified green band limit of ±5%.

NOTE: Since the Frequency Converter's STATUS INDICATOR meter M1 and shunt resistor R11 across M1 have a total allowable tolerance of ±3%, the indication on the Frequency Converter STATUS INDICATOR meter can be used to verify the existing condition of the power supply voltage.

(3) Set the meter selector switch S2, on the Power Supply-Blower, to the +12V position.

(4) Measure +12 volts DC on STATUS INDICATOR meter M1 (green line). If there is a slight difference, record it for comparison with step (5).

(5) Set the meter selector switch S2 to -12V position and measure -12 volts DC (green line) on STATUS INDICATOR meter M1.

(6) Observe, on the DC VTVM, the voltage indication at test point TP5. It should be -12 vdc.

NOTE: Since the meter calibration control for the +12V and -12V power supplies on the STATUS INDICATOR meter M1 is the same, the indications can again be used to verify the existing condition of the power supply voltages.

k. If necessary, adjust +12V VOLTS ADJ potentiometer R6 for precisely +12 volts DC as observed on the DC VTVM at test point TP4.

l. Set the meter selector switch S2 to +12V position.

m. If necessary, adjust the 12V meter calibration potentiometer R19 for the green line limit on STATUS INDICATOR meter M1.

n. Connect a well-calibrated DC VTVM to test point TP5 and measure -12 vdc. It should be within ±2%.

NOTE: If the indication is more than -12 vdc ±5% and in doubt whether it is the voltage or the measuring instrument that is inaccurate, proceed as follows:

(1) Set FUNCTION SELECTOR SWITCH S1 on the Frequency Converter Panel to position 5.

(2) Check that the indication of -12 volts dc as observed on STATUS INDICATOR meter M1 of the Frequency Converter is within the specified green band limit of ±5%.

NOTE: Since the Frequency Converter's STATUS INDICATOR meter M1 and shunt resistor R12 across M1 have a total allowable tolerance of ±3%, the indication on the Frequency Converter STATUS INDICATOR meter can be used to verify the existing condition of the power supply voltage.

(3) Set the meter selector switch S2 to the -12V position.

(4) Measure -12 volts DC on STATUS INDICATOR meter M1 (green line). If there is a slight difference, record it for comparison with step (5).

(5) Set the meter selector switch S2 to the +12V position and measure +12 vdc on STATUS INDICATOR meter M1 (green line).

NOTE: Since the meter calibration control for the +12V and -12V power supplies on the Status Indicator meter is the same, use these indications to again verify the existing condition of the power supply voltages.

o. Adjust, if necessary, -12V VOLTS ADJ potentiometer R10 for precisely -12 vdc as observed on the DC VTVM at test point TP5.

p. Set the meter selector switch S2 to the -12V position.

q. The indication on STATUS INDICATOR meter M1 should be within the green line limit.

NOTE: Do not readjust potentiometer R19, which was adjusted in step m.

r. Connect an Oscilloscope to test point TP2 and observe that the ac ripple on the +24 vdc supply voltage is not greater than 10 mv peak-to-peak.

s. Connect the Oscilloscope to test points TP3, TP4 and TP5 respectively, and observe that the ac ripple on the -24, +12 and -12-vdc supply voltages is no greater than 10 mv peak-to-peak.

NOTE: The measurements in steps r and s are made to make sure that no excessive ripples or oscillations exist.

t. Set the meter selector switch S2 on the Power Supply-Blower to 24 VAC (OVENS) position.

u. The STATUS INDICATOR meter M1 should indicate within the red color unit band.

NOTE: No adjustment is provided for the 24 vac oven voltage.

v. If the indication is more than ±15% (red unit band), the reading can be compared with that of the Frequency Converter. Proceed as follows:

(1) Set FUNCTION SELECTOR SWITCH S1 on the Frequency Converter to position 11.

(2) Check that the indication of 24 vac oven voltage as observed on STATUS INDICATOR meter M1 of the Frequency Converter is within the specified red band limit of ±15%.

NOTE: Since the Frequency Converter's STATUS INDICATOR meter M1 and shunt resistor R21 have a total tolerance of ±7%, the indication on the Frequency Converter STATUS INDICATOR meter can be used to verify the existing condition of the power supply voltage.

w. Restore the equipment for normal operation.

RF PRESELECTOR TEST AND ALIGNMENT PROCEDURE

General

Test and alignment procedures are performed when the requirements of a formance test are not met and the trouble is localized to the RF Preselector. All and alignment procedures are performed with the equipment out of service. A F Sweep Generator, Frequency Meter, Directional Coupler, Ferrite Circulator, illoscope, Detector and 50-ohm Termination are required for this procedure.

Test Procedure

a. Connect the test equipment as shown in figure 4-48. Terminate the output port of the directional coupler into a 50-ohm Termination (RF Preselector not in setup).

NOTE: Make sure all test cables have a characteristic impedance of 50 ohms. Microwave cables should be less than one foot and other cables less than six feet long.

b. Set the Sweep Generator to the assigned operating frequency (center frequency -f_o) of the RF Preselector.

c. Adjust the Frequency Meter until the marker is observed on the center of the Oscilloscope.

d. Check the linearity of the Sweep Generator output and adjust it, if necessary.

e. Connect the equipment as shown in figure 4-48 with the Preselector Input J1 connected to the Directional Coupler and Preselector Output J2 connected to the 50-ohm Termination.

f. Observe that a flat response is obtained on the oscilloscope screen as shown in figure 4-48.

g. Increase sensitivity of the Oscilloscope and observe that over a frequency range of f_o ±4.0 mc, the response variation is within one centimeter with the Oscilloscope sensitivity set at one millivolt/centimeter.

h. If the requirement of step f and g are not met, align the RF Preselector.

NOTE: Two alignment procedures are included herein:

a. A quick alignment procedure entails presetting the resonator tuning controls according to a calibration curve and subsequently optimizing the resonator tunings for a flat top response shape.

b. An alternate alignment procedure entails the sequential electrical tuning of the five filter resonators. This alternate procedure should be employed when the quick procedure does not provide satisfactory results.

3. Quick Alignment Procedure

A UHF Sweep Generator, Frequency Meter, Directional Coupler, Ferrite Circulator, Oscilloscope Detector, and 50-ohm Termination are required for this procedure.

a. Connect the test equipment as shown in figure 4-48 with the Directional Coupler terminated in a 50-ohm load. (Preselector not in setup.)

NOTE: Make sure all test cables have a characteristic impedance of 50 ohms. Microwave cables should be less than one foot and other cables less than six feet long.

b. Set the Sweep Generator to the assigned operating frequency (center frequency -f_o) of the RF Preselector.

c. Adjust the Frequency Meter until the marker is observed on the center of the Oscilloscope.

d. Preset the Preselector tuning plunger as shown in figure 4-49. The setting should be in the "A" portion on the plunger.

e. Check the linearity of the Sweep Generator output and adjust it, if necessary

f. Connect the equipment as shown in figure 4-48, with the Preselector Input J1 connected to the Directional Coupler and Preselector Output J2 connected to the 50-ohm Termination.

g. Adjust tuning plunger Z1 through Z5 for the flat test response on the Oscilloscope as shown in figure 4-48.

h. Increase sensitivity of the Oscilloscope and fine-adjust the tuning plunger. Over a frequency range of f_o ±4.0 MHz, the response variation should be within 1 centimeter with the Oscilloscope sensitivity set at 1 millivolt/centimeter.

NOTE: Adjusting tuning plunger clockwise will increase the operating frequency. Adjusting tuning plunger counterclockwise will decrease the operating frequency.

i. Watch the Oscilloscope, while locking the tuning controls, to make sure that the RF Preselector is not detuned.

Alternate Alignment Procedure

a. Repeat steps a, b and c as per paragraph 3 (Quick Alignment Procedure).

b. Turn all resonator tuning plungers counterclockwise to a zero dial reading in the "A" portion on the plungers. This detunes all resonators to the low frequency end of their tuning range.

c. Check the linearity of the Sweep Generator Output and adjust it, if necessary.

d. Connect the equipment as shown in figure 4-48 with the Preselector Input J1 connected to the Directional Coupler and the Preselector Output J2 connected to the 50-ohm Termination.

e. Adjust tuning plunger Z1 until a sharply-peaked response curve appears to move across the Oscilloscope presentation.

f. Continue to adjust Z1 until the marker is centered on the first peak (A, figure 4-50).

NOTE: Adjust tuning plungers clockwise to increase the operating frequency and counterclockwise to decrease the operating frequency.

g. Adjust tuning plunger Z2 until a second sharply-peaked response curve appears to move across the Oscilloscope presentation.

h. Continue to adjust Z2 until the marker is centered in the valley between the first and second sharply-peaked responses (B, figure 4-50).

i. Adjust tuning plunger Z3 until a third sharply-peaked response curve appears to move across the Oscilloscope presentation.

j. Continue to adjust Z3 until the marker is centered on the peak of the second sharply-peaked response (C, figure 4-50).

k. Adjust tuning plunger Z4 until a fourth sharply-peaked response curve appears to move across the Oscilloscope presentation.

l. Continue to adjust Z4 until the marker is centered in the valley between the second and third sharply-peaked responses (D, figure 4-50).

m. Adjust tuning plunger Z5 until the Oscilloscope presentation approximates, as close as possible, the waveform shown in E, figure 4-50.

n. Detune the Frequency Meter in order to remove the marker from the Oscilloscope presentation.

o. Narrow the sweep width until the Oscilloscope presentation approximates the waveform shown in F, figure 4-50.

p. Increase the sensitivity of the Oscilloscope and fine-adjust the tuning plungers to obtain the flattest response on the waveform. Over a frequency range of f_o ±4 mc, the response variation should be within one, with the Oscilloscope sensitivity set at one millivolt per centimeter.

q. Watch the Oscilloscope, while locking the tuning controls, to make sure that the RF Preselector is not detuned.

NOTE: Flatness of response shape can be improved using input/output coupling adjustments L1 and L2. These screw adjustments are factory set to optimize the position of the input/output coupling loops. It is not recommended that L1 and L2 be readjusted during ordinary field alignments of the RF Preselector.

MECHANICAL MAINTENANCE

Removal and Cleaning Blower Filter

The Power Supply-Blower Filter should be removed and cleaned at regular rvals. The amount of time between cleaning should be determined by conditions sting at the site, but should be at least once a month.

a. Remove the four front-panel screws securing the Filter Grill and Filter to the Power Supply-Blower Housing and remove the Filter.

b. Replace with a spare Filter or leave the air intake open for a short time until the old filter is cleaned.

c. Wash the Filter with strong soap, detergent, or solvent. Rinse and dry. Dip the Filter in SAE 30, or heavier oil, and drain for 24 hours.

d. Replace the Filter in the equipment or in stock as applicable.

Removal and Replacement of Printed Circuit Cards

An open end wrench (RF CONN KEY) and a Printed Circuit Card Extractor ol (PC EXTRACTOR) are provided in the Demodulator drawer to facilitate the moval of cables and the extraction of cards.

a. If cable connectors must be removed from a Printed Circuit Card, remove the wing nut that fastens the RF CONN KEY (wrench) to the side of the drawer.

   CAUTION: Be careful when using the wrench. The cable connectors are easily damaged.

b. Use the wrench to loosen the cable connectors and to remove the cables from the Printed Circuit Card.

c. Grasp the ring and press the top of the PC EXTRACTOR to remove it from its holder in the drawer.

d. Grasp the ring and press the top of the PC EXTRACTOR to insert it into the opening on the top of the Printed Circuit Card.

e. Using the ring only, pull the Printed Circuit Card straight up and remove it carefully from the card compartment.

f. Replace the Printed Circuit Card by sliding it into the card compartment until it is firmly seated in the receptacle.

3. Removal and Replacement of Oscillator Crystals

The crystal of the Oscillator-Doubler in the Frequency Converter must occasionally be removed and replaced. This procedure should only be performed wh the crystal is suspected of being faulty or when the Oscillator Doubler frequency is being changed. Use the following procedure:

a. Remove all cables (use the open-end wrench if necessary) from the Oscillator Module under test.

CAUTION: Be careful when using the wrench; the cable connectors are easily damaged.

b. Remove the two screws that clamp the Oscillator Module in the drawer.

c. Pull the Oscillator Module straight up to unplug it from its socket.

d. Remove the screws that fasten the Oven Housing to the Oven Base. Remove the Oven Housing from the Oscillator Module.

e. Remove the four screws that fasten the Oven-Insert in the Oven and remove the Oven-Insert.

f. Remove the crystal and replace it with a new one.

g. Line up the Key-Pin and slide the Oven-Insert back into the Oven.

h. Fasten the Oven-Insert to the Oven with the four screws.

i. Fasten the Oven Housing to the Oven Base.

j. Plug the Oscillator Module into the socket in the drawer.

k. Replace the Module Clamp and fasten with two screws.

l. Replace all cables for normal operation.

m. After a 30-minute warmup period, recheck the frequency with the new crystal in the oven.

4. Replacement of Step-Recovery Diode CR1 in SRD Multiplier

The step-recovery diode in the SRD Multiplier must occasionally be removed and replaced. This procedure should only be performed when the diode is suspected of being faulty.

a. Remove the four screws which secure the SRD Multiplier Input Box (shown in figure 4-51) to the remainder of the SRD Multiplier.

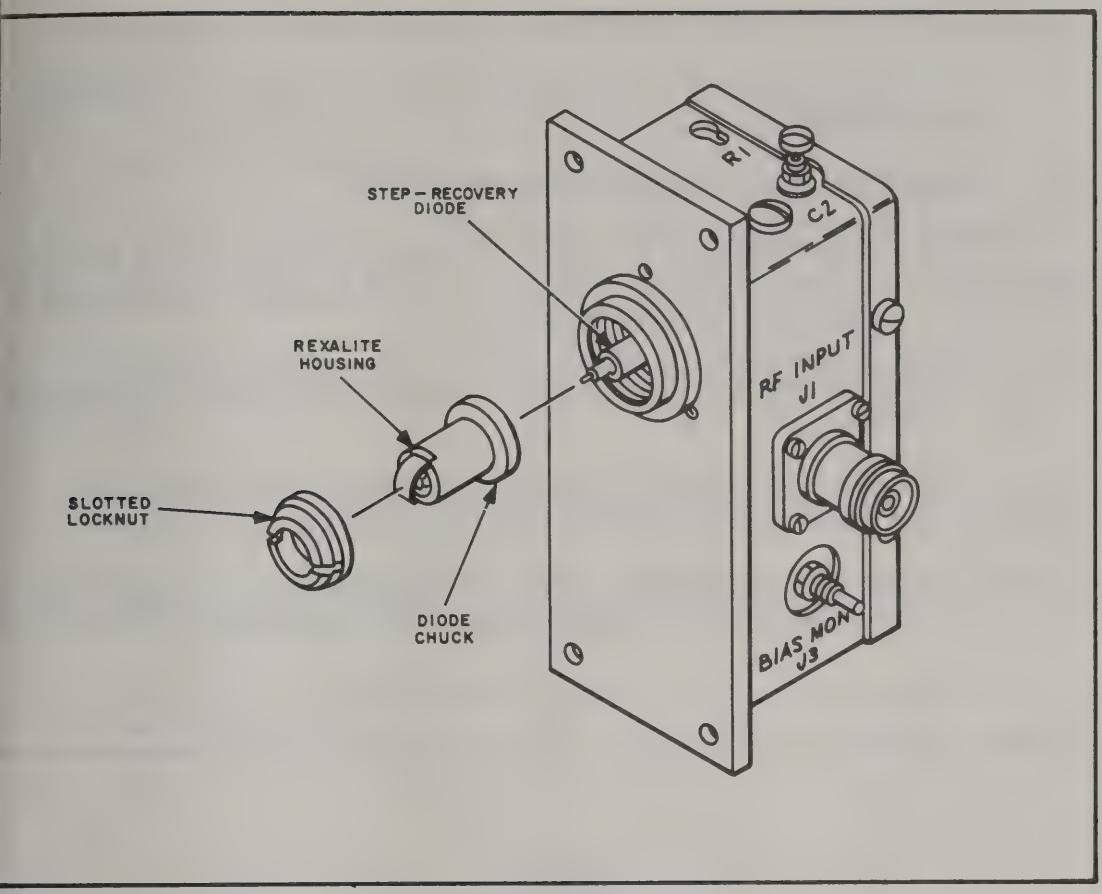


Figure 4-51. SRD Multiplier Input Box

b. Remove the Input Box and expose the diode housing.

c. Using the special two-pronged tool supplied, or long nosed pliers used with care, unscrew the slotted locknut.

d. Note the position of the curved metal contact before removing the Rexalite housing; it must be replaced in the same position.

e. Remove the Rexalite housing, which contains the diode chuck, by pulling it straight out. This exposes the diode.

f. Remove the diode.

g. Insert the new diode into the chuck, taking care to observe the correct polarity. Apply an even pressure with the fingers until the diode fits snuggly.

h. Replace the Rexalite housing and secure it with the slotted locknut.

i. Reconnect the SRD Multiplier Input Box to the remainder of the SRD Multiplier.

5. Removal and Replacement of Equipment Drawers

To maintain operation or to facilitate maintenance and repair, the equipment drawer may have to be removed or replaced. To avoid damage to the drawer slides or dropping the equipment, two men should be used.

a. On the inside of the two drawer handles, pull the triggers to release the handle levers.

b. Pull the handle levers down to their horizontal positions and pull the drawer out until it locks in its extended position.

c. Inside of the Equipment Housing, to the right of the telescoping tubing, pu the knurled release pin from the key-slotted support bracket (figure 4-52)

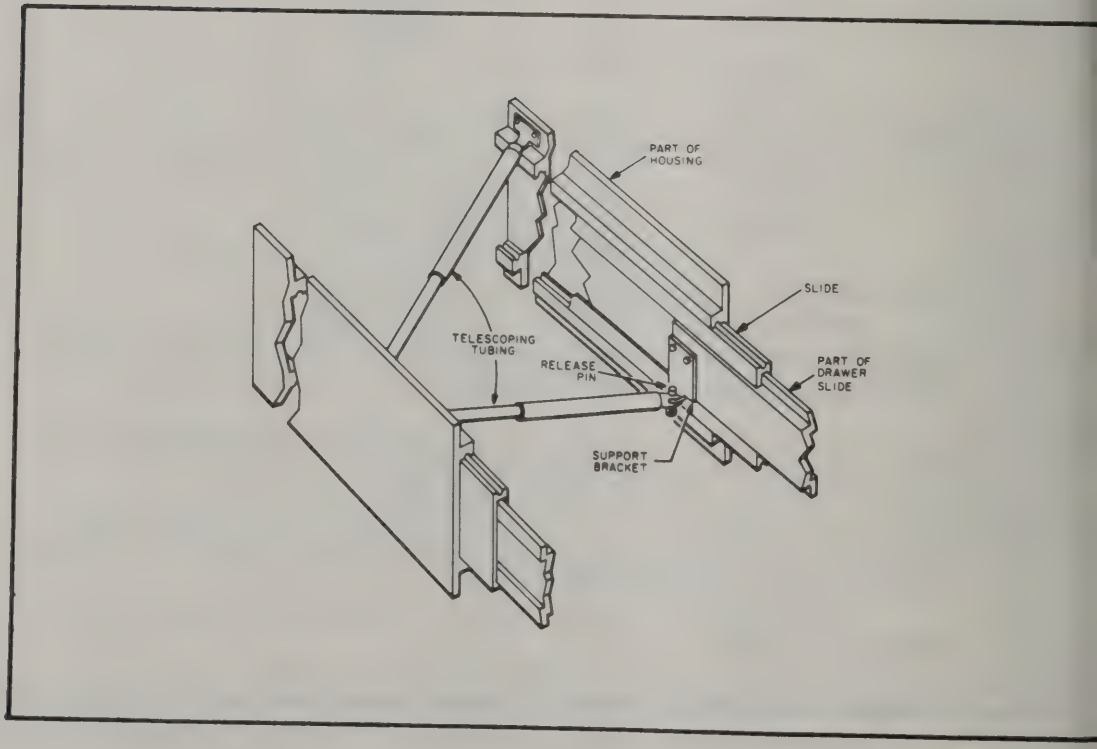


Figure 4-52. Details of Drawer Slides

d. Remove any external cables and the ground strap that may be connected to the drawer.

e. Press in the slide locks located on each drawer slide and remove the drawer from the Housing.

f. To replace the drawer, repeat steps (a) through (e) in the reverse order.

Installation of Air Duct Extension

The rigid Air Duct Extension is connected between the Receiver Housing and Power Supply-Blower drawer when it is open (figure 4-53). Use the following cedure for this installation.

a. Slip the end of the Air Duct Extension (with the clamp on the outside of the Housing) between the rear of the drawer and the inside of the Housing.

b. Place the air duct openings on each end of the Air Duct Extension to the air duct openings on the housing and the drawer respectively.

c. Tighten the wing-nut on the clamp until the Air Duct Extension is held securely in place.

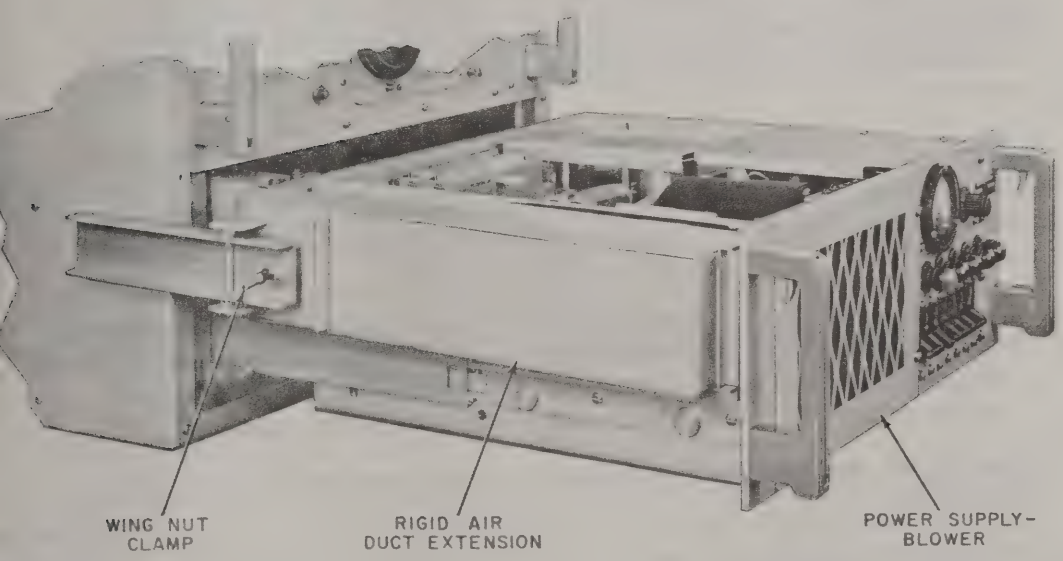


Figure 4-53. Air Duct Extension Installed

L. METERING CIRCUIT AND PILOT ADJUSTMENTS FOR REL TYPE 22772 RECEIVER DEMODULATOR DRAWER

1. METERING CIRCUIT ADJUSTMENT

Since receiver pilot adjustment and monitoring facilities depend upon the proper operation of the front panel meter, it is always good practice to check out the metering circuits.

Proceed with adjustment as follows:

a. Using the drop-out test-set, check the deviation of the modulator or modem for proper value.

b. Connect equipment as shown in Fig. 4-54. Apply a test tone of 30 Kc., or other baseband frequency, to the BB input, at a level of -45 DBM (1.54 MV at 75 ohms).

c. Set FUNCTION SELECTOR switch S1 to position 7. Adjust METER CAL potentiometer R24 on the Meter Amplifier and Detector module, 23090, for a zero indication on the front-panel meter.

d. Set FUNCTION SELECTOR switch S1 to position 8. Adjust GAIN ADJ potentiometer R5 on the Meter Amplifier and Detector module 23090 for an indication of 7 on the front panel meter. This sets the test tone level reference.

e. Set FUNCTION SELECTOR switch S1 successively to positions 3, 4, 5, and 6. Adjust METER DC SENSITIVITY ADJ potentiometer R21 so that each position of the switch indicates within the edges of the green color band.

Note: Potentiometer R21 is located behind the meter module. Before removing meter module, turn off power supply, remove 4 front panel screws. Turn on power supply--make adjustment--re-check steps d & e . Turn off power supply--reinsert meter module--turn on power supply.

Normally the meter amplifier is very stable and does not require major adjustments.

2. PILOT LEVEL ALIGNMENT

This alignment assures that the receiver will be taken off the line (combiner will be muted) upon failure of distant-end carrier and consequent loss of pilot, so that high noise level will not be fed to the baseband amplifier.

As a matter of information. There is an "automatic radio pilot defeat", also alled a pilot-reflex (see Pilot Amplifier Schematic, 23541), which unmutes all eceivers when all distant-end carriers or pilots fail. This circuitry protects gainst distant-end pilot generator failure but would allow high noise levels to appear n the baseband in the event of complete distant-end carrier failure. Appearance of igh level baseband noise is protected against by the Baseband Squelch Unit (noise perated) which is external to the receiver.

Proceed with alignment as follows:

a. Take the combiner off the buss by turning the combiner switch of Monitor Control Module 23601 to "defeat". It is assumed that the pilot in the modulator is operating and is set at a level of -10db below test tone.

b. Connect a 70-mc sample from an exciter through a 20-db attenuator to the IF INPUT connector J1 of IF Amplifier - (1). On the Monitor Control module, insert built-in test probe E2 (Red) in test point TP17 and test probe E1 (Black) to test point TP37. Set FUNCTION SELECTOR switch S1 to position 11. Connect the dc vtvm between test points TP10 on the combiner and TP40 (ground) on the Monitor Control Module, 23601.

c. The front panel meter should now read 7. If it does not read 7, adjust pilot level adjust potentiometer R7 on the Pilot Amplifier module 23541 for an indication of 7 on the front panel meter.

d. To test if the pilot protective control is operating (with the Radio Pilot Defeat Switch in the Normal position), adjust R7 of Pilot Amplifier module 23541 until the radio pilot fault lamp DS-12 comes on. This fault lamp should come on approximately at a reading of 5 on the meter.

   Note that a two second time delay exists. If the fault lamp does not go on near an indication of 5, adjust pilot adjust potentiometer R32, located on module 23541, for a setting of nominally 5 for the fault lamp to appear. Note that at same time as fault lamp goes on, TP6 located on module 23530, Noise Amplifier (2), will read nominally -7 volts.

e. Readjust pilot level adjust potentiometer R7 of pilot amplifier module 23541 for 7 volts on front panel meter.

3. PILOT REFLEX ADJUSTMENT

This pilot adjustment is normally made so as to assure that the combiner will be muted in the event of noise amplifier failure. However, to make the muting and fault alarm relays function reliably, output pilot voltages in excess of 1.5 V are required. In order to permit useful combining below about -60DBM (i.e. below which, DC control voltage due to out-of-band noise alone is less than 1.5V), which is considered more useful, the reflex circuit is made inoperative and the amount of

pilot fed thru the noise amplifier is adjusted only to a value which makes the DC control voltage floor equal in all receivers, and as low in value as possible.

Proceed with adjustment as follows:

Insert a dc vtvm into TP6 of module 23530 Noise Amplifier-(2). Adjust R22 pilot reflex level adjust, located on 23590 the Noise Amplifier Reflex and Recorder Amplifier card, to read 1 volt at TP6. Sometimes it maybe impossible due to residual noise level of noise amplifiers to set TP6 for one volt. Up to 1.3 volts residual reading is acceptable at TP6. Pilot level reflex adjust of 23590 must be set to such a point that it does not add to the reading of TP6. If the residual reading of one receiver noise amplifier (due to residual noise) is slightly higher than the others, but not greater than 1.3V, adjust the other receivers to the same value by adjusting R22 (i.e. adding pilot). If after this setting the pilot reflex alarm should light, reset R7 located on 23591 to extinguish the light. Reconnect J1.

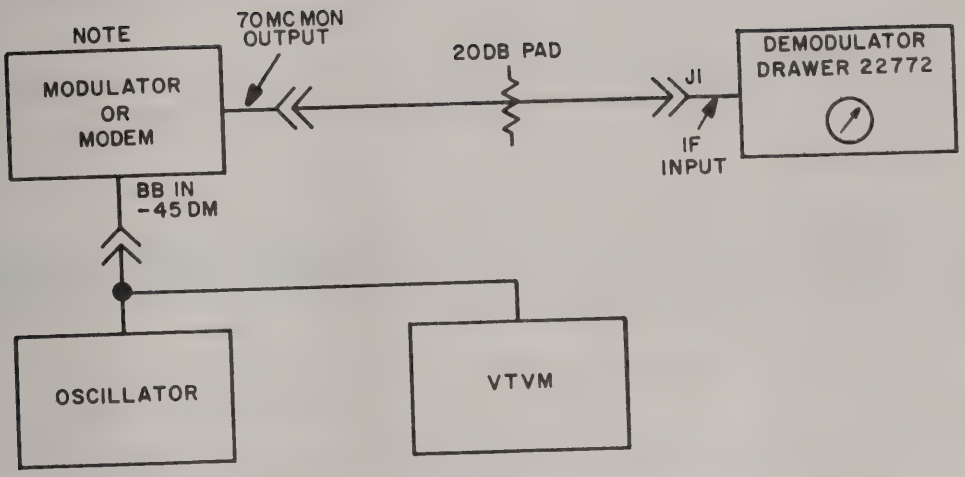
4. BASE BAND ALARM

This is a pilot operated device which lights fault indicator DS-10 and provides fault alarm in the event of Baseband Amplifier (23551) failure. It does not provide automatic baseband amplifier disconnect. Normally, two base-band amplifiers are operated in parallel, and the level loss resulting from the failure of one baseband amplifier can be corrected at the patching panel.

There are no pilot level adjustments, but the circuitry should be checked for proper operation. The minimum level to prevent baseband alarm is -25DBM. (i.e. correct pilot level without message baseband). Alarming occurs when the total baseband output drops to -28DBM.

Check the operation as follows:

Disconnect the input to baseband input module 23551. Alarm light DS-10 should be activated. If alarm amplifier module 23582 is inoperative, trouble is either in a shorted IN645 diode, defective relay K1, or an inoperative amplifier. To trouble shoot the amplifier use audio test points TP-1 and TP-4 and TP-6 which indicates the rectified control voltage (DC). Further details are given in the book with the REL module tester.



NOTE:
THE USE OF THE PERFORMANCE MONITOR MODEM ALLOWS THE SECOND EXCITER MODULATOR TO ACT AS A STANDBY FOR THE MODULATOR WHICH IS IN SERVICE.

Figure 4-54. Metering Circuit and Pilot Amplifier Block Diagram.

M. TUNNEL DIODE AMPLIFIER TUNING AND ALIGNMENT PROCEDURE

Please note that all TDA's should be modified to work off the power supply. REL ECN's 14498, 14493 and 14490 have been issued for this purpose.

1. GENERAL

The purpose of this procedure is to outline the adjustments and performance tests for the Tunnel Diode Amplifier (TDA). This procedure should be reviewed prior to making any operational adjustments to the TDA.

The TDA amplifies due to its negative resistance characteristics. It operates in the reflection mode. The TDA bandwidth, for all practical purposes, is established by the circulator. (Fig. 4-55 shows all major components and tuning controls.) The only time TDA adjustments are warranted is under the following conditions:

a. Drop in gain below 15 db.
b. Increase in noise figure above 5.5 db.
c. Oscillation.

NOTE: One must exercise care that the second stage noise does not affect noise figure readings taken with the TDA. As an example, assume the down converter has a noisy crystal mixer or local oscillator (step recovery diode (SRD) frequency multiplier output stage of injection chain). A noise figure as high as 20 db could be obtained. Using the test set-up of Fig. 4-62 and the down converter input terminated with 50 ohms, the output noise level on the Boonton meter should read approximately 2.7 millivolts when the down converter noise figure is 10 db. Assuming the mixer and IF preamplifier have been swept for proper amplitude response, a measured output noise level (and higher noise figure) much greater than 2.7 millivolts suggests the possibility of excessive local oscillator noise from the SRD. Try adjusting the SRD controls Z2 and J2 in small increments to obtain noise reduction. If SRD noise can not be reduced by this simple method, please refer to paragraph G for a complete SRD alignment.

Another, even more sensitive, method of minimizing SRD injection noise is to hook up the IF amplifiers in the normal manner and observe the noise in a baseband slot (80 kHz) while applying a strong enough RF input to the down converter to produce 20 db of quieting. As SRD adjustments are made and noise reduction results, the signal generator output can be gradually reduced to maintain the 20 db quieting point. If SRD adjustment does not entirely reduce output noise level to 2.7 millivolts try changing the mixer diode in the down converter.

If the gain of the TDA is down to 13 db and the converter has a noise figure of 20 db the total noise figure, even though the TDA might have a 4.5 db noise figure, the RF system noise figure will be:

$$NF_{total} = NF_{TDA} + \frac{NFm \quad -1}{\text{Gain of TDA (power)}}$$

$$NF_{tot} = 2.82 + \frac{100 \ -1}{20} = 2.82 + 5 = 7.82$$

A noise factor of 7.82 = 8.95 db (i.e. 10 log 7.82).

One way to eliminate second stage noise is by the use of two TDA's in cascade, followed by the down converter. This procedure is sometimes useful when one is trying to establish the performance of the TDA itself.

2. PRELIMINARY PROCEDURES & PRECAUTIONS

a. Check the bias voltage and readjust potentiometer if voltage is not 1.35 ±0.05 volts DC.

b. Check operation of TDA heater.

c. If TDA has been out of service, turn on and allow 45 minute warm-up time prior to any test or adjustment.

d. The TDA will start compressing above an input level of -45 dbm. See Fig.4-56 for dynamic range response. As an example, when measuring the gain of ~~the~~ TDA at an input level of -40 dbm, add 1.5 db to the actual gain measured. Therefore keep the input level below -45 dbm when making gain measurement or using sweeping techniques.

e. When measuring gain always add cable losses. For RG8/U and RG9/U this is 0.14 db per foot at 2 GHz.

f. Put a 20 db pad at TDA input when using a Signal Generator.

g. Before making any TDA adjustments or measurements, be sure that the test equipment is operating properly. Sweep patterns should be steady and linear when the unit under test is not in the circuit. The Boonton RF voltmeter should not be fluctuating as a result of local interference or AC ground loops. If good test conditions are not established, test results will be useless or doubtful.

h. When using the sweep technique, use an absorption type frequency meter to establish the carrier frequency on the sweep display. If no absorption meter is available, lightly couple into the TDA input through a tee connector, using a Signal Generator as the marker. If using the Alfred sweeper

markers, make certain of the frequency by comparing them to the Frequency Meter or Signal Generator.

3. GAIN ADJUSTMENT

Set up the test equipment as shown in Fig. 4-57. Test the sweep set-up without the TDA inserted, to establish proper sweep and resolution. The swee pattern must be stable and the sweeper ALC circuits must be operating properl

a. TDA has low gain and does not oscillate.

Adjust BIAS for maximum display pattern. Rotate clockwise or counter-clockwise to find point of maximum. If BIAS adjustment should cause oscillation (break-up of pattern, abrupt changes in sweep pattern, change in baselines, etc.), use Frequency Adjust Control to eliminate oscillation. If this still does not help, turn gain adjust clockwise to eliminate oscillatio If nothing helps, the diode may be seated improperly or may be defective. However, the difficulty may also be due to a peculiar combination of the settings of the BIAS, GAIN and FREQUENCY CONTROLS.

b. Assuming the bias is set for maximum gain or almost maximum gain and and there are no defective parts in the amplifier, proceed as follows:

Carefully and slowly turn the gain adjust CCW and observe a change in gain. This may not be uniform over the sweep spectrum observed. If the gain has been raised slightly (one can determine the degree by reducing the sweep generator attenuator and noting the difference in sweep gain control setting to restore the former pattern amplitude), readjust the frequency control for the most symmetrical response. Do not turn this control more than is necessary to prevent introduction of oscillation. If adjusting the gain control should cause oscillation, use the frequency control to eliminate oscillation. Adjust the bias control for maximum sweep pattern display. Now, check gain of TDA using the set-up of Fig.4-58. If gain is at least 17 db but not mo than 19 db, tune-up is completed. If gain is less than 17 db repeat procedure of increasing gain. If gain is above 19 db reduce gain to 18 db.

NOTE 1: To eliminate oscillations during or at the start of this procedure, first try stabilization with the frequency control. If not successful, turn gain control clockwise until oscillation stops. When killing oscillations with the gain control only, gain after stabilization may be very low. To increase gain again work the GAIN and FREQUENCY controls in small steps as outlined above.

NOTE 2: The amplifier response may be as close as 7 MHz to the edge of the display cutoff. If it is any closer, adjust the FREQUENCY control and try to move the operating frequency at least 7 MHz off the cut off point. The cut off point is defined as the 1 db response. Sometimes the center frequency of the response can be shifted by tightening or loosening the CHUCK DIELECTRIC (see Fig.4-55). It also tends to flatten the response. The bandwidth of the TDA at the 3 db points should be at least 50 MHz. It may be desirable to shift TDA's around, if one exhibits better characteristics at a given frequency and the replaced TDA is adequate for another frequency.

NOISE FIGURE MEASUREMENTS

The most desirable method of establishing the TDA noise figure is by using g.4-59A. Sometimes the second TDA of a different frequency can be used. Any DA which has above 10 db gain and reasonable NF at the desired operating frequency, ay be used as the second TDA. If set-up A is not practical, use set-up B. Always heck the noise figure test set-up by removing the first stage. A reduction in residual oise caused by the first stage gain should be noted. If this does not occur, second tage noise is present or possible grounding problems exist.

In making measurements of noise figure, when the noise figure is less than db, it is important to carefully take into account all cable losses, lamp temperature orrections, and amplifier performance. Connecting cables between the noise lamp nd the amplifier under test should be as small as possible (always under one foot ength) -- if not eliminated entirely. Applications of curves 4, 5 and 6 in the AIL nstruction Book are usually required. Application of curve 6 is difficult since the orrection applied by this curve is a function of lamp temperature. The lamp will eat up sufficiently the first time it is fired to require a correction. After two firings he lamp temperature is practically stabilized. The power supply applies a "starting oltage" to the tube, which is sufficient to cause the generation of some noise even hough the lamp is not fired. Therefore, turn the power supply switch "off" when etermining the initial Y factor reference reading. It is suggested REL curves ig. 4-60 and Fig. 4-61 be utilized, since they are easier to apply and yield ore consistent results. In addition it must be realized that the Y factor btained from various lamps may vary as much as 0.25 db. All IF amplifiers ust be linear in operation and properly terminated. (Note the use of a 6 db ad in Figure 4-59A and Figure 4-59B which is a precautionary measure to ssure good termination.)

. NOISE FIGURE OPTIMIZATION

If the noise figure measured is not 4.5 db carefully turn the BIAS control, in uarter turn steps, and measure noise figure each time. If the noise figure degrades n one direction, turn in the other direction. Normally, turning the bias control will ause a loss in gain. If too much gain is lost the second stage noise will become a

factor. Any loss in gain due to optimizing the bias for best noise figure must be regained by the method of gain adjustment previously described.

It has been found that the optimized noise figure is either at maximum gain position of the bias control or close to it. Variation in bias is the only method of noise optimization. If the absolute noise figure of the TDA cannot be reduced to at least 5.5 db a change in diode must be considered.

6. TUNNEL DIODE REPLACEMENT

If it has been firmly established that the tunnel diode is defective and must be replaced, a replacement diode must be requested from REL. The diode is a special selected gallium antimonide diode. Since the parameters of the replacement diode must be similar to the original diode values, it is essential that the serial number of the amplifier (located on the front panel) as well as the frequency of operation be provided. The replacement diode will be provided with a new ceramic washer from REL.

To replace the tunnel diode in the field, the following steps must be performed:

a. Place switches SW1 and SW2 in the off position and disconnect main power cord.

b. Remove 12 screws securing top cover of module 24350 Housing and remove cover to expose TDA module.

c. Remove 8 screws securing cover on TDA module and remove cover.

d. Unsolder wire connected to the bias lead tube and unscrew chuck dielectric pressure control screw. Lift up bias lead tube which contains tunnel diode and its associated mounting assembly.

e. With a small cloth or soft paper, carefully plug hole in TDA module left by removal of tunnel diode assembly, and remove all pieces of ceramic washer in the module.

NOTE: Remove strip of teflon tape located around inside edge of chuck assembly to facilitate removal of ceramic pieces.

f. Remove old tunnel diode from its mount and carefully press in new replacement.

g. Remove cloth or paper applied in step e above and place new ceramic washer in position. Replace teflon tape in chuck assembly.

h. With a No. 050 allen wrench, turn diode contact adjustment screw counter clockwise to its stop.

i. Replace diode with its associated mounting assembly into TDA module and screw in (clockwise) the chuck dielectric pressure control until it is firmly against the ceramic washer.

NOTE: The chuck dielectric pressure control will normally crack the ceramic washer as it is tightened. If left too loose, some pieces of ceramic washer may fall into the TDA module cavity which will require disassembly for removal. Conversely, if the pressure control is over-tightened, it may cause separation of the diode mounting assembly from the TDA module.

j. Solder wire to bias lead tube.

k. Proceed with TDA tuning as previously described under GAIN and NOISE FIGURE OPTIMIZATION.

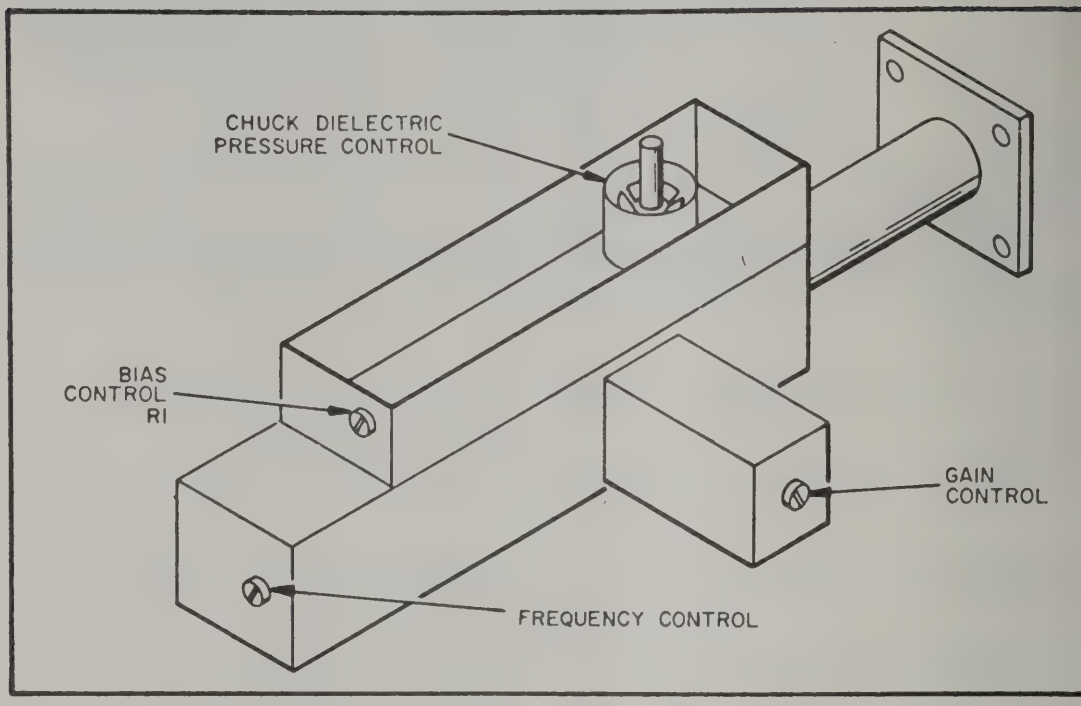


Figure 4-55. Tunnel Diode Controls

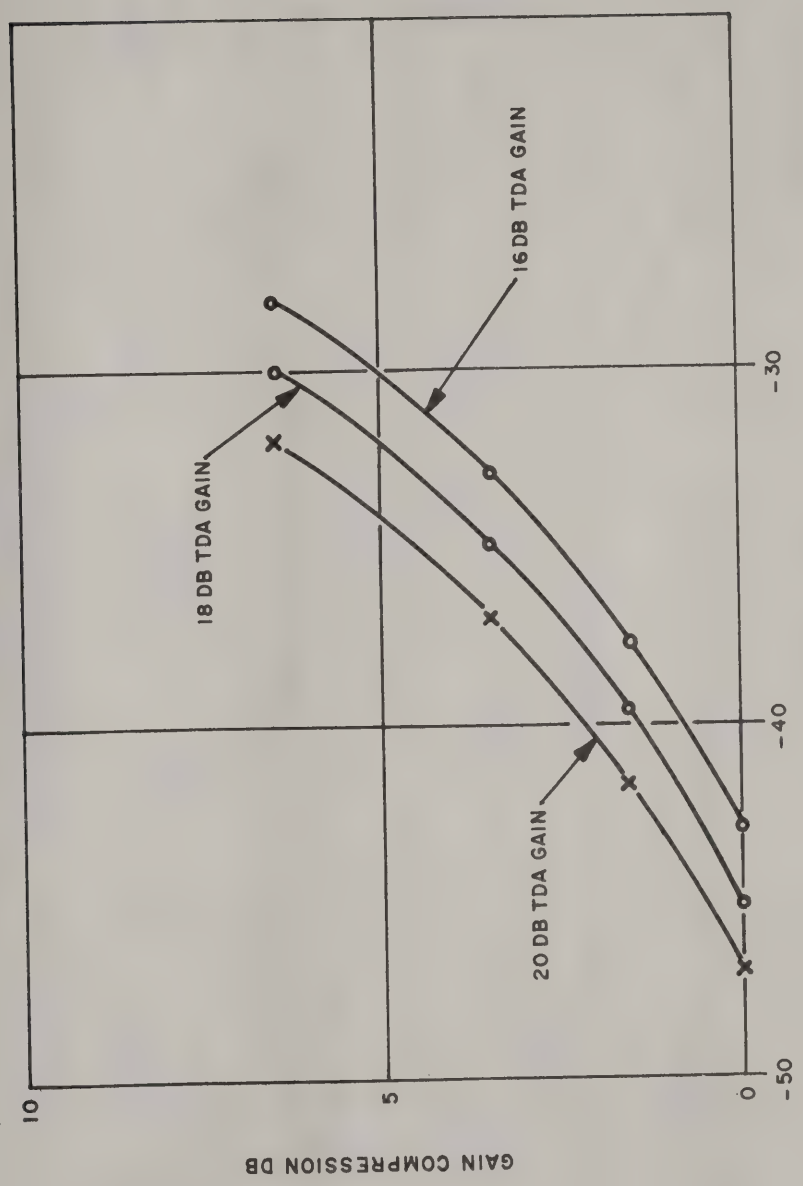
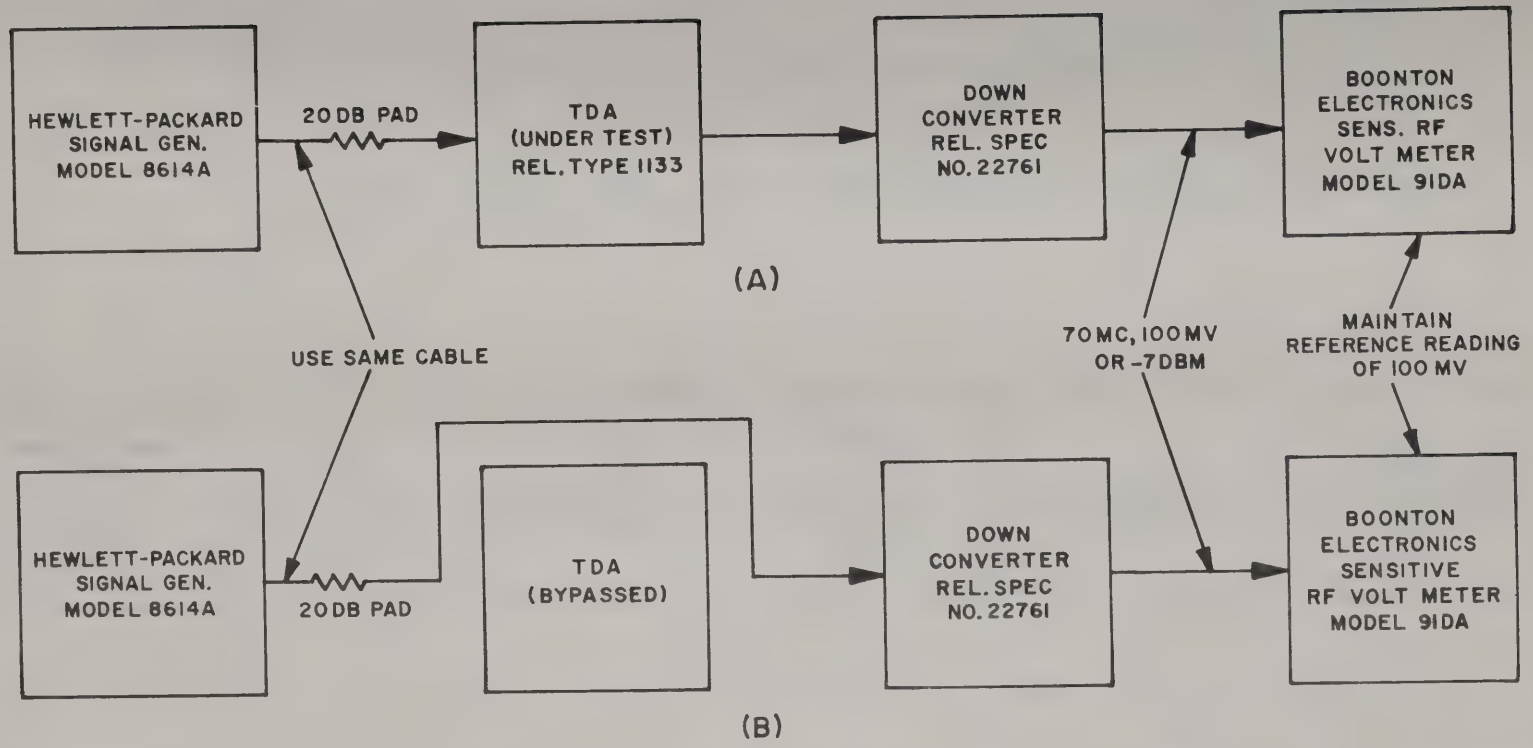


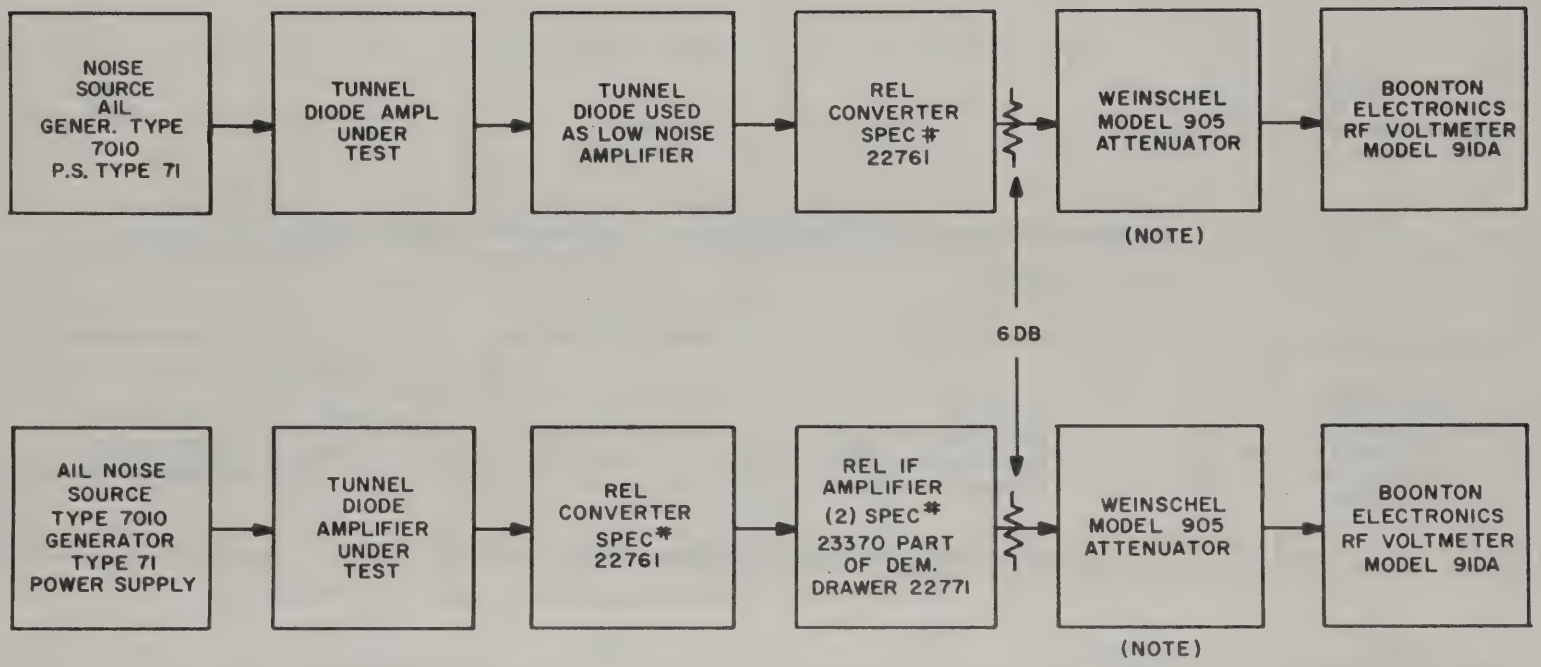
Figure 4-56. Tunnel Diode Amplifier Gain Compression

ALFRED
SWEEP SIGNAL
GENERATOR MODEL
631D-S1
10DB PAD
HEWLETT-PACKARD
TYPE 536A
FREQUENCY METER
10 OR 20DB
PAD
LEVEL SHOULD NOT
EXCEED -40 DBM
TUNNEL DIODE
AMPLIFIER
RADIO ENGINEERING
LAB. TYPE 1135
SWEEP
OUTPUT
HOR. INPUT
TEXTRONIX
OSCILLOSCOPE
TYPE 516A
HOR. INSERT TYPE 2A60
VERT. INSERT TYPE 3A72
SET TO 0.01 VOLT SCALE
VERT. OUTPUT
INPUT
OUTPUT AT REAR
HEWLETT-PACKARD
TYPE 400EL
VOLT METER
SET TO SCALE -60DB
OR USE MINIMUM GAIN
OF AMPLIFIER WHICH
GIVES USUABLE SCOPE
DISPLAY
INPUT
ALFRED
MODEL 1001
DETECTOR



METHOD OF MEASUREMENT:
COMPARE SIGNAL GENERATOR ATTENUATOR SETTINGS FOR ACTUAL GAIN OF TDA.

Figure 4-58. Measurement of Amplifier Gain



NOTE
USE TWO MODEL 905 IN SERIES, IF AVAILABLE. PURPOSE OF ATTENUATOR IS TO PROVIDE GREATER ACCURACY AND TO KEEP BOONTON METER READING ON SAME SCALE.

Figure 4-59. Noise Figure Measurement Setup

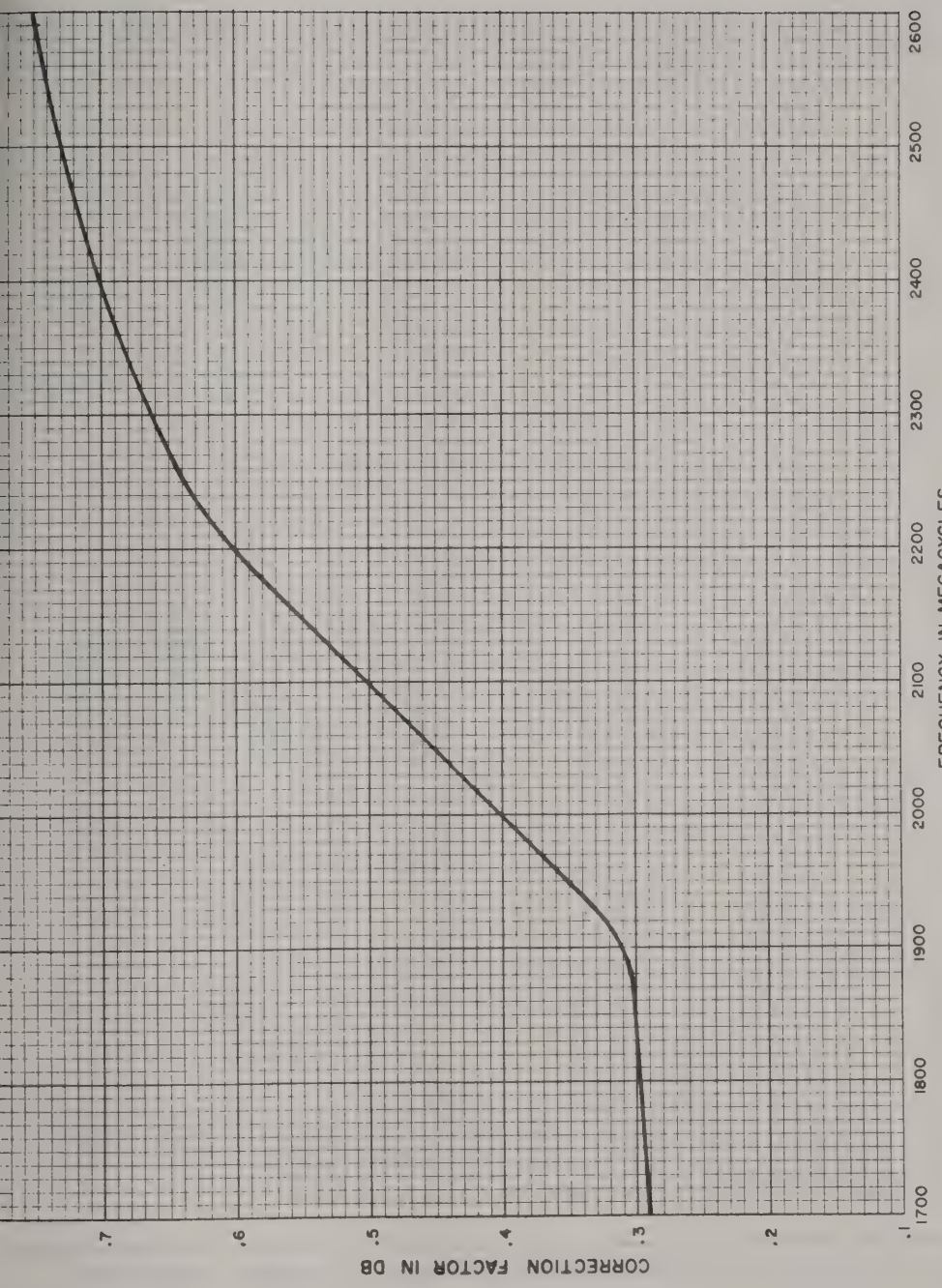


Figure 4-60. Correction Curve For Use With AIL 7010 Noise Generator

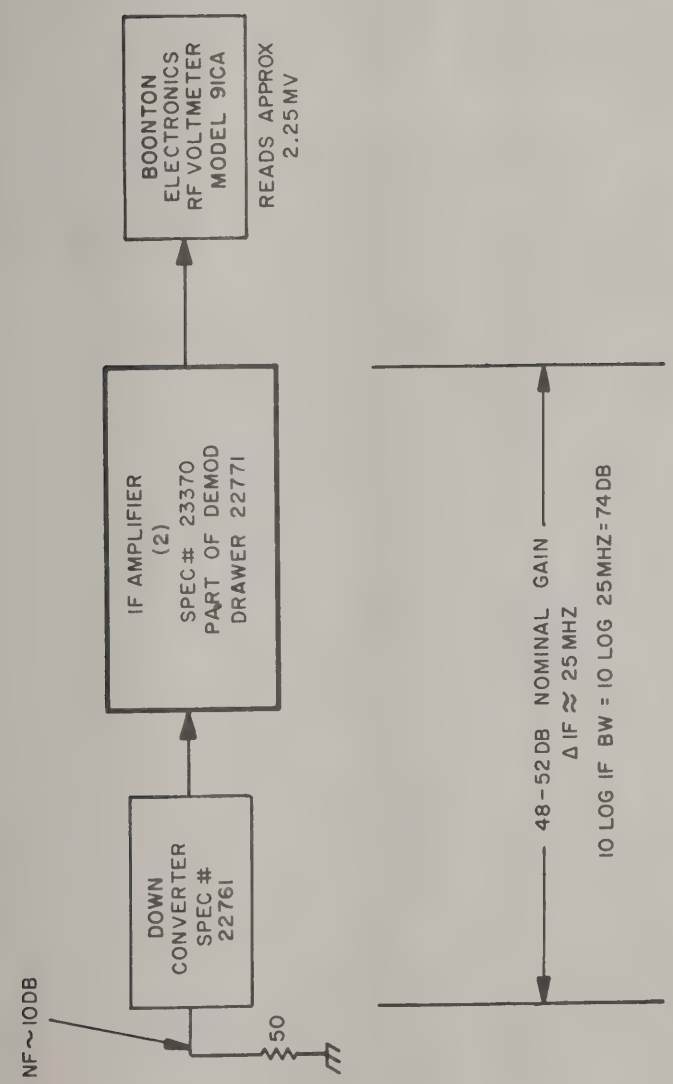
AIL NOISE FIGURE CHART*

"Y" Factor	Eq Noise Fig.	"Y" Factor	Eq Noise Fig.	"Y" Factor	Eq Noise Fi
5.0	12.2	8.0	8.1	11.0	4.6
5.1	12.1	8.1	7.9	11.1	4.5
5.2	12.0	8.2	7.8	11.2	4.4
5.3	11.8	8.3	7.7	11.3	4.3
5.4	11.6	8.4	7.6	11.4	4.18
5.5	11.5	8.5	7.5	11.5	4.05
5.6	11.3	8.6	7.3	11.6	3.91
5.7	11.2	8.7	7.2	11.7	3.8
5.8	11.1	8.8	7.1	11.8	3.69
5.9	11.0	8.9	6.9	11.9	3.58
6.0	10.8	9.0	6.8	12.0	3.49
6.1	10.7	9.1	6.7	12.1	3.37
6.2	10.5	9.2	6.6	12.2	3.27
6.3	10.2	9.3	6.5	12.3	3.17
6.4	10.0	9.4	6.4	12.4	3.06
6.5	9.9	9.5	6.2	12.5	2.95
6.6	9.8	9.6	6.1	12.6	2.85
6.7	9.7	9.7	6.0	12.7	2.74
6.8	9.6	9.8	5.9	12.8	2.63
6.9	9.5	9.9	5.8	12.9	2.52
7.0	9.3	10.0	5.7	13.0	2.43
7.1	9.2	10.1	5.5	13.1	2.32
7.2	9.1	10.2	5.4	13.2	2.21
7.3	9.0	10.3	5.3	13.3	2.11
7.4	8.8	10.4	5.2	13.4	2.0
7.5	8.7	10.5	5.1	13.5	1.91
7.6	8.6	10.6	5.0	13.6	1.82
7.7	8.5	10.7	4.9	13.7	1.69
7.8	8.3	10.8	4.8		
7.9	8.2	10.9	4.7		

NOTES: "Y" Factor = DB Deviation, "Y" Factor in db
Eq Noise Fig. = Equivalent Noise Figure in db

*NOTE: Chart Requires Corrections for Different RF Carrier Frequencies.

Figure 4-61. Noise Figure Measurement Chart



NOISE = -174 + N.F. + IF BW + GAIN

NOISE/48 DB GAIN = -174 + 10 + 74 + 48 = -42 DBM = 1.8 MV

NOISE/52 DB GAIN = -174 + 10 + 74 + 52 = -38 DBM = 2.8MV

Figure 4-62. Noise Measurements of Down Converter

V. DIAGRAMS

This section contains the drawings and diagrams necessary for the equipment maintenance. The diagrams are alphabetically listed for convenience. The overall diagrams are listed first.

gure No.	Caption	Page No.
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5-6	Receiver housing, schematic diagram, Type 1130A	5-11
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5-16	Channel capacity selector, 72 channels, schematic diagram	5-25
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5-25	Demodulator, Type 1130A, schematic diagram	5-37
5-26	Distribution amplifier, schematic diagram	5-39
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5-28	Driver-discriminator, (72 channels), schematic diagram	5-41
5-29	Driver-discriminator, (132 channels), schematic diagram	5-43
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5-32	Frequency converter, schematic diagram	5-47
5-33	Front panel assembly, schematic diagram	5-49
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Figure No.	Caption	Pa
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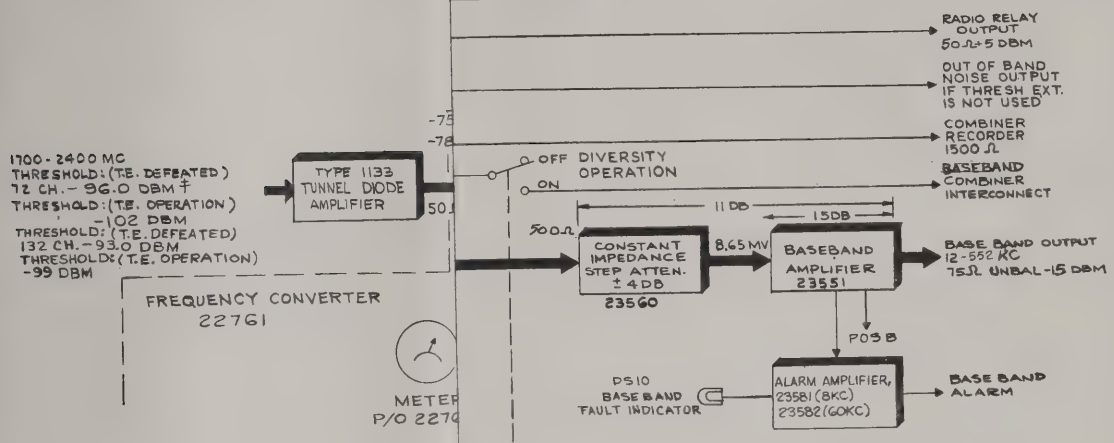
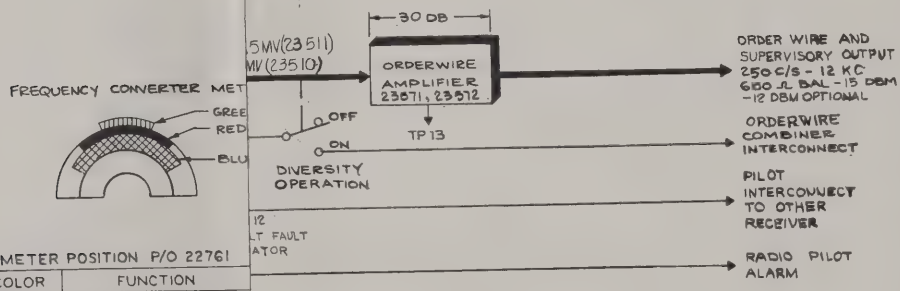
5-39	Meter amplifier and detector, schematic diagram	5-
5-40	Meter and switch assembly, schematic diagram	5-
5-41	Mixer cavity, schematic diagram	5-
5-42	Mixer (demodulator), Type 1130, schematic diagram	5-
5-43	Monitor control (frequency donverter), schematic diagram . . .	5-
5-44	Monitor control section (demodulator), schematic diagram . . .	5-
5-45	Noise amplifier (1), schematic diagram	5-
5-46	Noise amplifier (2), schematic diagram	5-
5-47	Noise amplifier reflex and recorder amplifier, Type 1130, schematic diagram	5-
5-48	Noise amplifier reflex and recorder amplifier, Type 1130A, schematic diagram	5-
5-49	Order wire amplifier, schematic diagram	5-
5-50	Oscillator-doubler, schematic diagram	5-
5-51	Pilot amplifier, schematic diagram	5-
5-52	Power supply-blower, schematic diagram	5-
5-53	Reference oscillator, Type 1130, schematic diagram	5-
5-54	Regulator (+12/+24 volts), schematic diagram	5-
5-55	Regulator (-12/-24 volts), schematic diagram	5-
5-56	Solid-state switch, Type 1130, schematic diagram	5-
5-57	SRD multiplier, schematic diagram	5-
5-58	Transfer, Type 1130, schematic diagram	5-
5-59	VCO and doubler, Type 1130, schematic diagram	5-
5-60	Wideband amplifier, Type 1130, schematic diagram	5-

DC METER READINGS

	LIMITS	TP NO	FUNCTION	LIMITS
TAGE	3 MIN	TP25	VCO BUFFER AMPL - OUTPUT TO S.S. SWITCH	2 TO 10
	3 TO 9	TP26,27	VCO BUFFER AMPL - OUTPUT TO T.E. MIXER	2 TO 10
MP LIMIT.	3 TO 9	TP28	VCO BUFFER AMPL - VCO BIAS OUTPUT	3 TO 9
E. MIXER	3 TO 9	TP29	AFC REFERENCE OSC - OUTPUT	3 TO 9
PUT	3 TO 9	TP30	AFC COMP - LIMITER INPUT (S.S SW OUT)	3 TO 9
		TP31	AFC COMP - LIMITER OUTPUT	3 TO 9
	3 TO 9	TP34	CHOPPER DEMODULATOR BIAS OUTPUT	3 TO 9
	3 TO 9	TP37	GROUND	
	5 TO 9	TP38	SPARE	
	2 TO 10	TP39	SPARE	
PUT	3 TO 9			
	3 TO 9			





METER POSITION P/O 22761

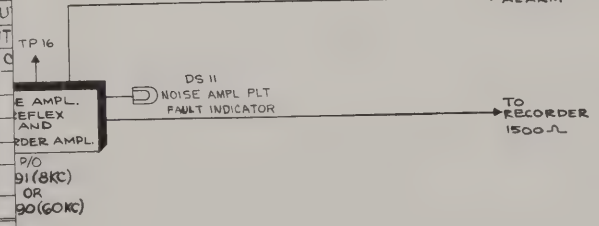
POS	COLOR	FUNCTION
1	BLUE	MIXER CRYSTAL CURREN
2	GREEN	+ 24 V
3		- 24 V
4		+ 12 V
5		- 12 V
6	RED	SRD MULTIPLIER OUTPU
7		LF AMPLIFIER OUTPUT
8		OSCILLATOR DOUBLER C
9		SPARE
10		SPARE
11	BLUE	24 VAC OVEN
12		TEST POINTS

TEST POINTS - POSITION 12

TEST PT. NO.	FUNCTION
1	GROUND
2	SRD MULT BIAS LEVEL

INDICATORS

DS1	OVEN CYCLING



1130-04

Figure No.	Caption
5-37	Limiters-discriminator, Type 1130, schematic diagram
5-38	Low frequency amplifier, schematic diagram
5-39	Meter amplifier and detector, schematic diagram
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5-56	Solid-state switch, Type 1130, schematic diagram
5-57	SRD multiplier, schematic diagram
5-58	Transfer, Type 1130, schematic diagram
5-59	VCO and doubler, Type 1130, schematic diagram
5-60	Wideband amplifier, Type 1130, schematic diagram

NOTE:
METER INDICATIONS DEPEND ON:
RF INPUT SIGNAL OF -60 dbm INTO TUNNEL DIODE AMPLIFIER
* INDICATION WITH 12 KC TEST TONE
** INDICATION WITH RF INPUT OF -100 dbm
*** INDICATION WITH PILOT TONE PRESENT
**** INDICATION WITH 1 KC ORDER WIRE TEST TONE

† 72 CHANNEL CASE
# 72 CHANNEL CASE - T.E. OPERATION

12 POSITION SWITCH P/O 23611

POS	COLOR	FUNCTION	REMARKS
1	270 S	BASEBAND COMBINER CURR	
2	270 S	ORDERWIRE COMBINER CURR	
3	GRN	+24 V	
4	GRN	-24 V	
5	GRN	+12 V	
6	GRN	-12 V	
7		SPARE	
8#	GRN	BASEBAND AMPL OUTPUT	
9		AFC FS = 1.0 KC	
10		AFC FS = 10.0 KC	
11		DC TEST POINTS	
12		AC TEST POINTS	

INDICATORS

FAULT INDICATION		BASEBAND AMPLIFIER (DS10)
		NOISE AMPLIFIER PILOT (DS11)
		RADIO PILOT (DS12)
DEFEAT INDICATION	THRESHOLD EXTENSION IN (DS 5)	
		THRESHOLD EXTENSION (DS3)
		DIVERSITY COMBINER (DS4)
		NOISE AMPLIFIER PILOT (DS1)
OVEN HEATER INDICATION		RADIO PILOT (DS2)
		REFERENCE OSCILLATOR (DS8)
		VCO AND DOUBLER (DS7)
		DRIVER-DISCRIMINATOR (DS9)
		RADIO PILOT FILTER (DS6)

AC METER READINGS

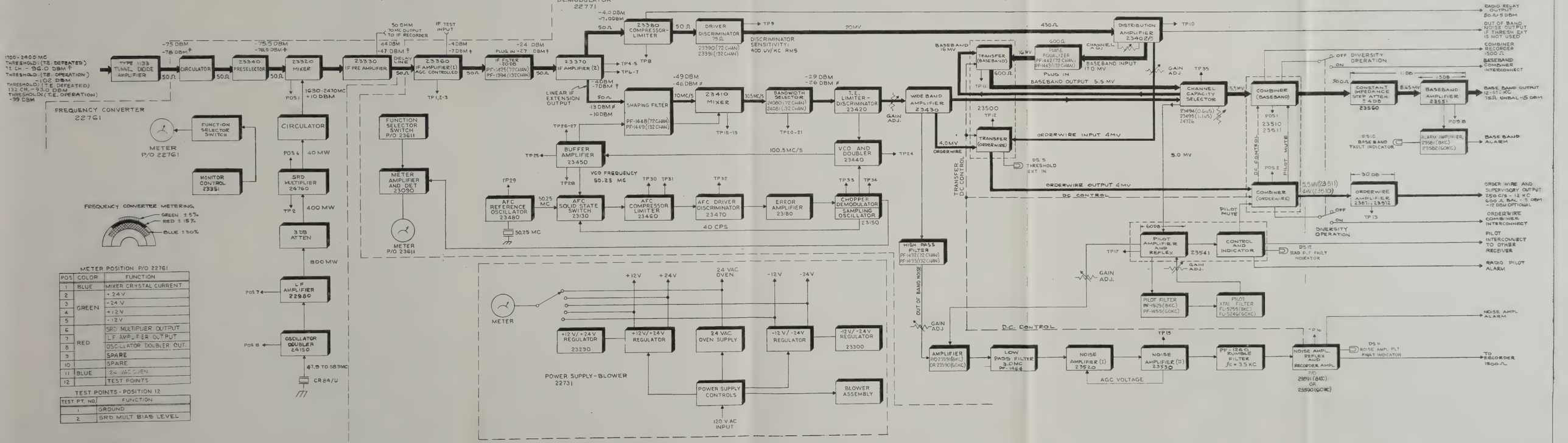
TP NO	FUNCTION	LIMITS
TP9 *	DRIVER DISCRIM.-DISCRIM. OUTPUT	3 TO 9
TP10 *	DISTRIBUTION AMPLIFIER- OUTPUT	5 TO 9
TP11 *	TRANSFER - BASEBAND OUTPUT	5 TO 9
TP12 ****	TRANSFER- ORDERWIRE OUTPUT	3 TO 9
TP13 ***	ORDERWIRE AMPLIFIER - OUTPUT	RED
TP32 *	AFC DRIVER DISCRIM.-OUTPUT	0 TO 4
TP31	CHOPPER DEMOD & SAMPLG OSC-OUTPUT	5 TO 9
TP35 *	CHANNEL CAPACITY SEL-OUTPUT	5 TO 9
TP36	24 VAC OVEN	3 TO 9

DC METER READINGS

TP NO.	FUNCTION	LIMITS
TP1	IF AMPLIFIER I - AGC VOLTAGE	3 MIN
TP2,3	IF AMPLIFIER I - OUTPUT	3 TO 9
TP4,5	IF AMPLIFIER II-OUTPUT TO CCH LIMIT	3 TO 9
TP6,7	IF AMPLIFIER II-OUTPUT TO T.E. MIXER	3 TO 9
TP8	COMP LIMITER - LIMITER OUTPUT	3 TO 9
TP14	SPARE	
TP15 ***	NOISE AMPLIFIER II - OUTPUT	3 TO 9
TP16	DC CONTROL VOLTAGE	3 TO 9
TP17 ***	PILOT AMPLIFIER - OUTPUT	5 TO 9
TP18,19	T.E. MIXER - OUTPUT	5 TO 10
TP20,21	BANDWIDTH SELECTOR OUTPUT	3 TO 9
TP22	SPARE	
TP23	SPARE	
TP24	VCO AND DOUBLER - OUTPUT	3 TO 9

DC METER READINGS

TP NO.	FUNCTION	LIMITS
TP25	VCO BUFFER AMPL-OUTPUT TO 55 SWITCH	2 TO 10
TP26,27	VCO BUFFER AMPL - OUTPUT TO T.E. MIXER	2 TO 10
TP28	VCO BUFFER AMPL - VCO BIAS OUTPUT	3 TO 9
TP29	AFC REFERENCE OSC - OUTPUT	3 TO 9
TP30	AFC COMP LIMITER INPUT 'S S SW OUT	3 TO 9
TP31	AFC COMP LIMITER OUTPUT	3 TO 9
TP34	CHOPPER DEMODULATOR BIAS OUTPUT	3 TO 9
TP37	GROUND	
TP38	SPARE	
TP39	SPARE	



METER POSITION P/O 22761

POS	COLOR	FUNCTION
1	BLUE	MIXER CRYSTAL CURRENT
2	GREEN	+24 V
3	GREEN	-24 V
4	GREEN	+12 V
5	GREEN	-12 V
6	RED	SRD MULTIPLIER OUTPUT
7	RED	LF AMPLIFIER OUTPUT
8	RED	OSCILLATOR DOUBLER OUT.
9		SPARE
10		SPARE
11	BLUE	24 VAC OVEN
12		TEST POINTS

TEST POINTS - POSITION 12

TEST PT. NO.	FUNCTION
1	GROUND
2	SRD MULT BIAS LEVEL

INDICATORS

DS1	OVEN CYCLING

FIGURE 5-1. RECEIVER, BLOCK DIAGRAM, TYPE 1130.

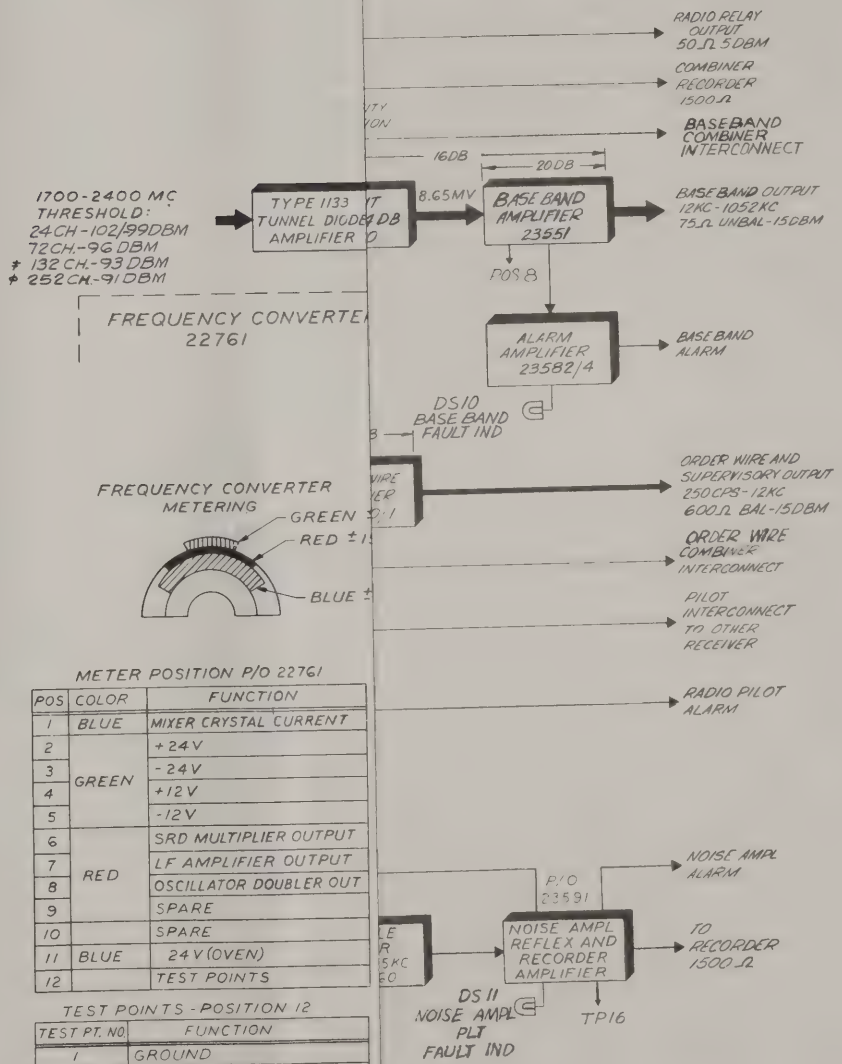
1130-04

NOTE:
METER INDICATIONS DEPE
RF INPUT SIGNAL OF -60 d
* INDICATION WITH 12KC TEST
** INDICATION WITH RF INPUT
+ + + INDICATION WITH PILOT TON
* * * * INDICATION WITH 1KC ORDE

‡132 CHANNEL CASE (6M
‡ 252 CHANNEL

DC. METER READINGS

TP25-31	NOT APPLICABLE	
TP34	NOT APPLICABLE	
TP37	GROUND	
TP38	SPARE	
TP39	SPARE	



METER POSITION P/O 22761

POS	COLOR	FUNCTION
1	BLUE	MIXER CRYSTAL CURRENT
2	GREEN	+24V
3		-24V
4		+12V
5		-12V
6	RED	SRD MULTIPLIER OUTPUT
7		LF AMPLIFIER OUTPUT
8		OSCILLATOR DOUBLER OUT
9		SPARE
10		SPARE
11	BLUE	24V (OVEN)
12		TEST POINTS

TEST POINTS - POSITION 12

TEST PT. NO.	FUNCTION
1	GROUND
2	SRD MULT BIAS LEVEL

INDICATORS

DS1	OVEN CYCLING

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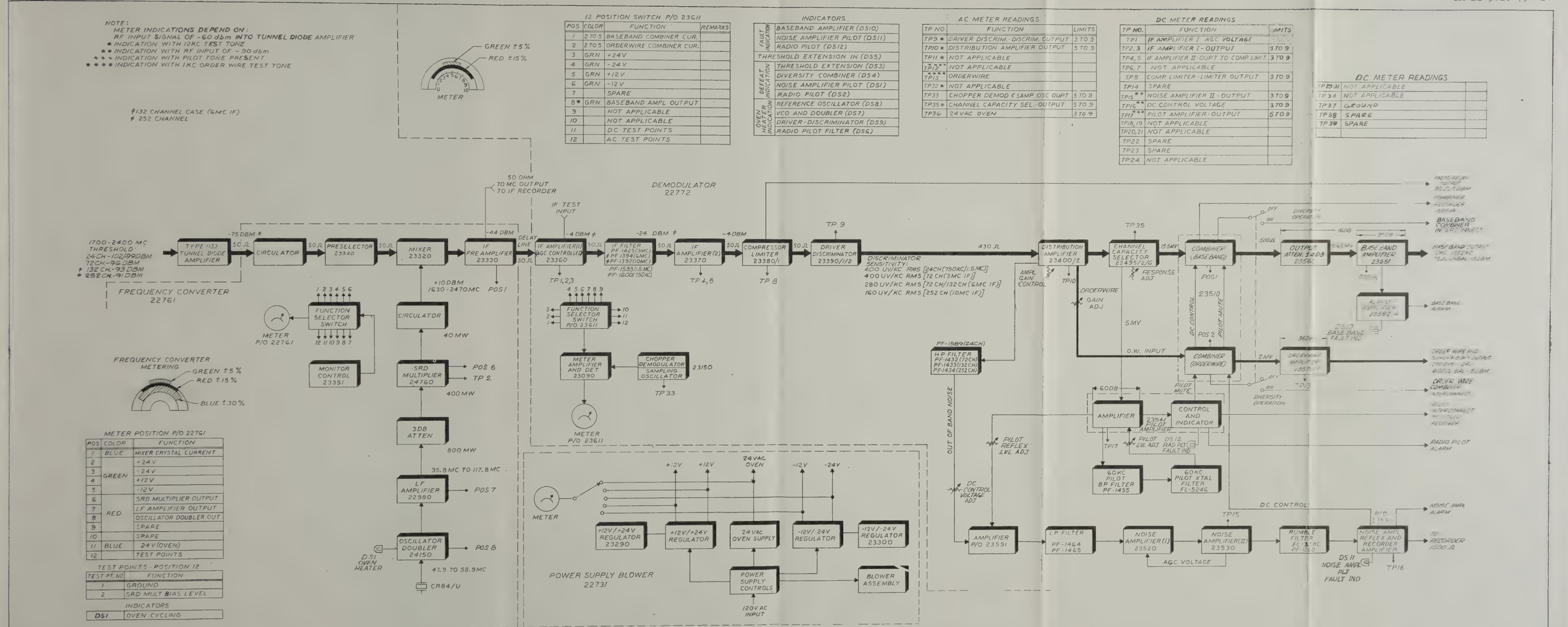
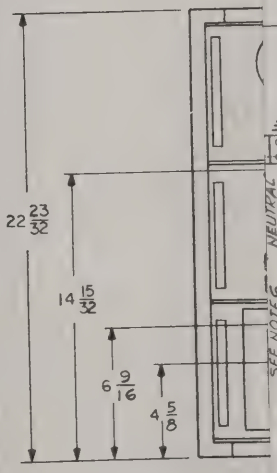


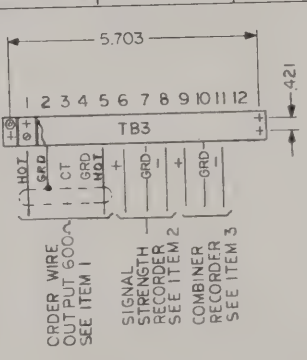
FIGURE 5—2. RECEIVER, BLOCK DIAGRAM, TYPE 1130A.

REVIATED.
E UNIT NO. 4.
PENDENT
TION.

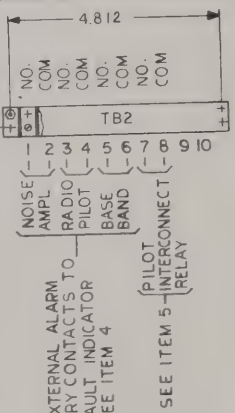
ABLES TO BE PROVIDED BY EQUIPMENT INSTALLING AGENCY

FROM		TO		WIRE OR CABLE	CABLE CONNECTION	
NIT	CONNECTOR	UNIT	CONNECTOR		ON RECEIVER	ON EQUIPMENT
EIVER	TB3 TERM 1,2,5	SEE NOTE 4	——	RG108A/U	BURNDY YAE 18-643	——
EIVER	TB3 TERM 6,7,8	SEE NOTE 4	——	RG108A/U	BURNDY YAE 18-643	——
EIVER	TB3 TERM 9,10,11	SEE NOTE 4	——	RG108A/U	BURNDY YAE 18-643	——
EIVER	TB2 TERM 1,2,3,4,5,6	SEE NOTE 4	——	6" 18 AWG	BURNDY YAE-18 Z2	——
EIVER	TB2 TERM 7,8	SEE NOTE 4	——	2" 18 AWG	BURNDY YEA 18-72	——
EIVER	CP7 DAGE 8002-1	COMPANION RECEIVER	CP7 DAGE 8002-1	RG62/U	DAGE 8004-1	DAGE 8004-1
EIVER	CP8 DAGE 8002-1	COMPANION RECEIVER	CP8 DAGE 8002-1	RG62/U	DAGE 8004-1	DAGE 8004-1
EIVER	CP9 DAGE 8002-1	COMPANION RECEIVER	CP9 DAGE 8002-1	RG58/U	DAGE 8000-1	DAGE 8000-1
CEIVER	CP4 DAGE 3269-1	SEE NOTE 4	——	RG59B/U	UG 603A/U	——
EIVER	J1 MICON 9084	SEE NOTE 4	——	RG223/U	DAGE 8000-1	——
EIVER	J2 MICON 9084	SEE NOTE 4	——	RG58C/U	DAGE 8000-1	——
EIVER	J3 MICON 9084	TO EXC (FOR LOS) OPERATION ONLY	MICON 9084	RG58C/U	DAGE 8000-1	DAGE 8000-1
CEIVER	J1 TYPE "N"	SEE NOTE 4	——	——	——	——
EIVER	TB1 TERM	RECEIVER COMPANION	TB1 TERM	3" 12 AWG	BURNDY YAE 12-N1	——
EIVER	CP5 DAGE 3269-1	CUSTOMER DELAYLINE (WHEN REQD)	——	RG214/U	UG 21 D/U	——
CEIVER	CP6 DAGE 3269-1	CUSTOMER DELAYLINE (WHEN REQD)	——	RG 214/U	UG21 D/U	——





DETAIL 3
NOT TO SCALE



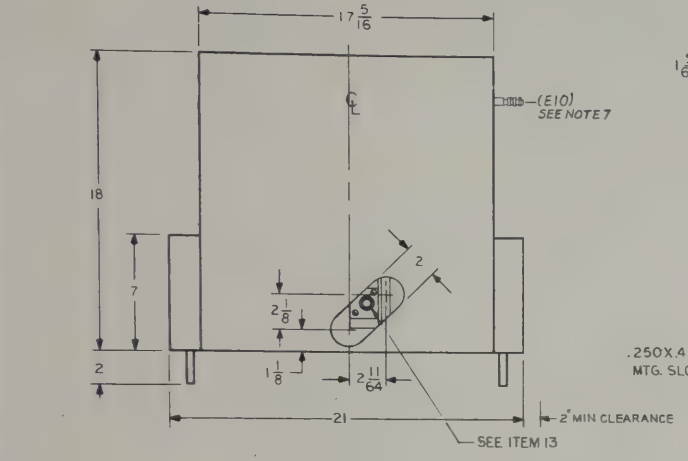
DETAIL 1
NOT TO SCALE

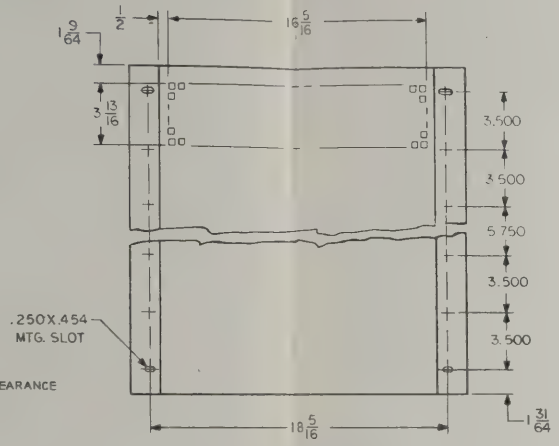
1130-11

NOTES:
1. A-JUMPER-REL SUPPLIED.
   B-DELAY LINE CAN BE SUBSTITUTED.
2. CP7, CP8, CP9, REL SUPPLIED.
3. REFERENCE DESIGNATIONS ARE ABBREVIATED. PREFIX THE DESIGNATIONS WITH THE UNIT NO.4.
4. CUSTOMER OPTION-TERMINATION DEPENDENT UPON SPECIFIC TERMINAL CONFIGURATION. *SEE NOTE 5, BELOW.*

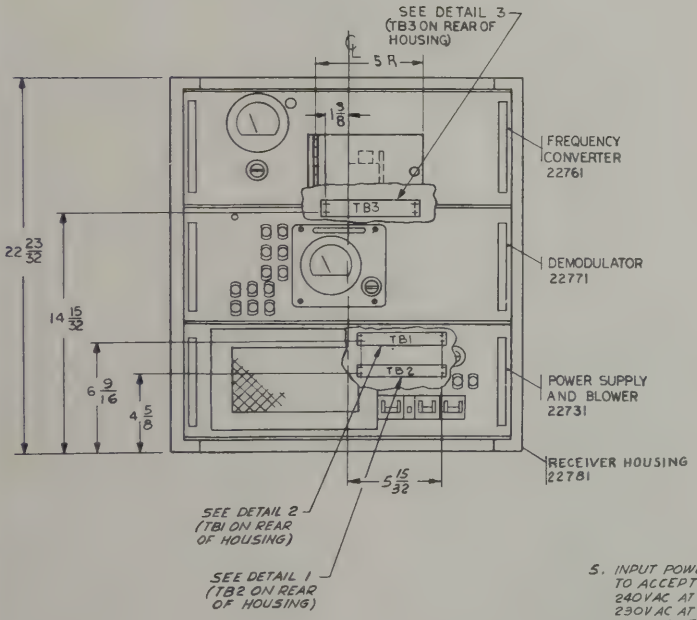
CABLES TO BE PROVIDED BY EQUIPMENT INSTALLING AGENCY

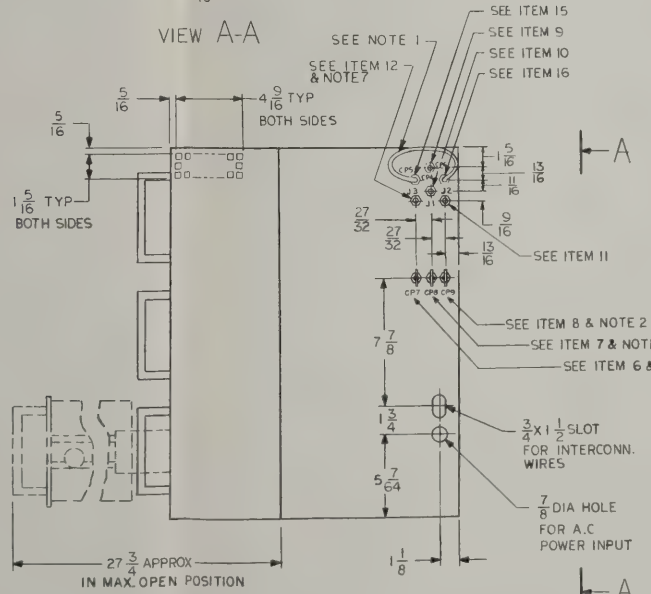
ITEM	FUNCTION	FROM		TO		WIRE OR CABLE	CABLE CONNECTION	
		UNIT	CONNECTOR	UNIT	CONNECTOR		ON RECEIVER	ON EQUIPMENT
1	ORDER WIRE OUTPUT 600Ω	RECEIVER	TB3 TERM 12,5	SEE NOTE 4	—	RG108A/U	BURNDY YAE 18-G43	—
2	SIGNAL STRENGTH RECORDER	RECEIVER	TB3 TERM 6,7,8	SEE NOTE 4	—	RG108A/U	BURNDY YAE 18-G43	—
3	COMBINER RECORDER	RECEIVER	TB3 TERM 9,10,11	SEE NOTE 4	—	RG108A/U	BURNDY YAE 18-G43	—
4	EXT ALARM DRY CONTACTS	RECEIVER	TB2 TERM 1,2,3,4,5,6	SEE NOTE 4	—	6#18AWG	BURNDY YAE 18 Z2	—
5	PILOT INTER-CONNECT RELAY	RECEIVER	TB2 TERM 7,8	SEE NOTE 4	—	2#18AWG	BURNDY YEA 18-72	—
6	BB COMBINER INTERCONNECT	RECEIVER	CP7 DAGE 8002-1	COMPANION RECEIVER	CP7 DAGE 8002-1	RG62/U	DAGE 8004-1	DAGE 8004-1
7	O.W. COMBINER INTERCONNECT	RECEIVER	CP8 DAGE 8002-1	COMPANION RECEIVER	CP8 DAGE 8002-1	RG62/U	DAGE 8004-1	DAGE 8004-1
8	PILOT REFLEX INTERCONNECT	RECEIVER	CP9 DAGE 8002-1	COMPANION RECEIVER	CP9 DAGE 8002-1	RG58/U	DAGE 8000-1	DAGE 8000-1
9	BASEBAND OUTPUT	RECEIVER	CP4 DAGE 3269-1	SEE NOTE 4	—	RG59B/U	UG 603A/U	—
10	MONITOR 70 MC INPUT	RECEIVER	J1 MICON 9084	SEE NOTE 4	—	RG223/U	DAGE 8000-1	—
11	IF RECORDER OUTPUT	RECEIVER	J2 MICON 9084	SEE NOTE 4	—	RG58C/U	DAGE 8000-1	—
12	RADIO RELAY OUTPUT	RECEIVER	J3 MICON 9084	TO EXC (FOR LOS) OPERATION ONLY	MICON 9084	RG58C/U	DAGE 8000-1	DAGE 8000-1
13	RF INPUT	RECEIVER	J1 TYPE "N"	SEE NOTE 4	—	—	—	—
14	POWER INPUT	RECEIVER	TB1 TERM	RECEIVER COMPANION	TB1 TERM	3#12 AWG	BURNDY YAE 12-N1	—
15	FREQ CONVERTER 70MC OUTPUT	RECEIVER	CP5 DAGE 3269-1	CUSTOMER DELAYLINE (WHEN REQD)	—	RG214/U	UG 21 D/U	—
16	DEMODULATOR 70 MC INPUT	RECEIVER	CP6 DAGE 3269-1	CUSTOMER DELAYLINE (WHEN REQD)	—	RG214/U	UG21 D/U	—

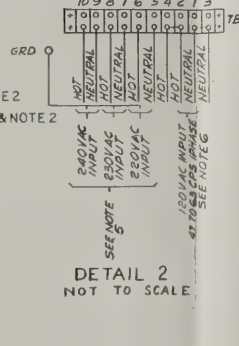


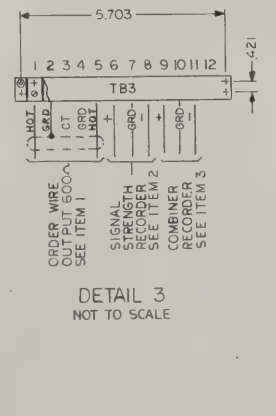


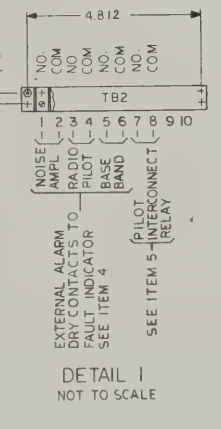
VIEW A-A











5. INPUT POWER TO EXCITER IS ARRANGED TO ACCEPT THE FOLLOWING:
   240VAC AT TERMINAL 9 & 10 OF TB1.
   230VAC AT TERMINAL 7 & 8 OF TB1.
   220VAC AT TERMINAL 5 & 6 OF TB1.
   JUMPER BETWEEN 2 & 4 AND 1 & 3 ARE USED ONLY WHEN AUTO TRANSFORMER IS SUPPLIED.
6. 120VAC INPUT IS APPLIED TO TERMINALS 1 & 2 OF TB1 IF AUTO TRANSFORMER IS NOT SUPPLIED
7. REMOVE E10 (50Ω TERMINATION) WHEN RADIO RELAY IS USED.

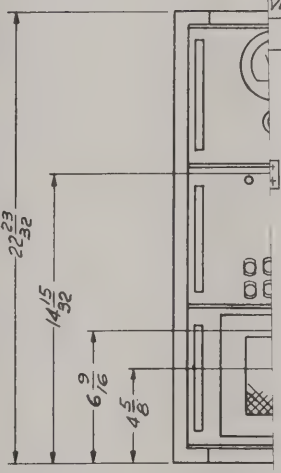
1130-11

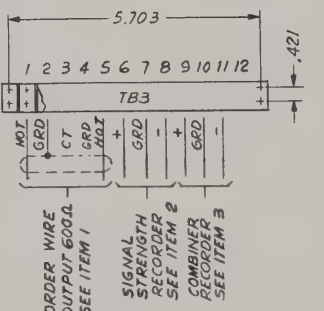
FIGURE 5-3. RECEIVER, INSTALLATION DIAGRAM, TYPE 1130.

TED.
BREVIATED.
VE UNIT NO.
EPENDENT
PATION.
RRANGED
TB1.
TB1.
TB1.
E USED
SUPPLIED.

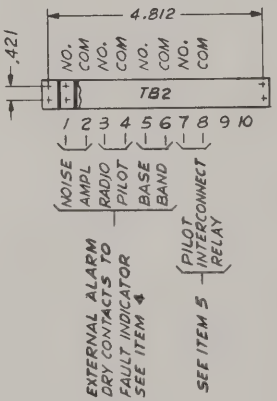
LES TO BE PROVIDED BY EQUIPMENT INSTALLING AGENCY

FROM		TO		WIRE OR CABLE	CABLE CONNECTION	
	CONNECTOR	UNIT	CONNECTOR		ON RECEIVER	ON EQUIPMENT
IVER	TB3 TERM 1,2,5	SEE NOTE 4	—	RG108A/U	BURNDY YAE 18-G43	—
	TB3 TERM 6,7,8	SEE NOTE 4	—	RG108A/U	BURNDY YAE 18-G43	—
	TB3 TERM 9,10,11	SEE NOTE 4	—	RG108A/U	BURNDY YAE 18-G43	—
	TB2 TERM 1,2,3,4,5,6	SEE NOTE 4	—	6# 18AWG	BURNDY YAE 18-Z2	—
	TB2 TERM 7,8	SEE NOTE 4	—	2# 18AWG	BURNDY YAE 18-Z2	—
	CP7 DAGE 8002-1	COMPANION RECEIVER	CP7 DAGE 8002-1	RG 62/U	DAGE 8004-1	DAGE 8004-1
	CP8 DAGE 8002-1	COMPANION RECEIVER	CP8 DAGE 8002-1	RG 62/U	DAGE 8004-1	DAGE 8004-1
	CP9 DAGE 8002-1	COMPANION RECEIVER	CP9 DAGE 8002-1	RG 58/U	DAGE 8000-1	DAGE 8000-1
	CP4 DAGE 3269-1	SEE NOTE 4	—	RG 59B/U	UG 603A/U	—
	J1 MICON 9084	SEE NOTE 4	—	RG 223/U	DAGE 8000-1	—
	J2 MICON 9084	SEE NOTE 4	—	RG 58C/U	DAGE 8000-1	—
	J3 MICON 9084	TO EXC (FOR LOS OPERATION ONLY)	MICON 9084	RG 58C/U	DAGE 8000-1	DAGE 8000-1
	J1 TYPE N	SEE NOTE 4	—	—	—	—
	TB1 TERM 0,1,2	COMPANION RECEIVER	TB1 TERM 0,1,2	3#12AWG	BURNDY YAE 12-N1	BURNDY YAE 12-N1
	CP5 DAGE 3269-1	CUSTOMER DELAY LINE (WHEN REQD)	—	RG 214/U	UG 21D/U	—
VER	CP6 DAGE 3269-1	CUSTOMER DELAY LINE (WHEN REQD)	—	RG 214/U	UG 21D/U	—





DETAIL 3
NOT TO SCALE



DETAIL 1
NOT TO SCALE

SEE DE
(TB1 ON
OF HOU

SEE D
(TB2
OF H

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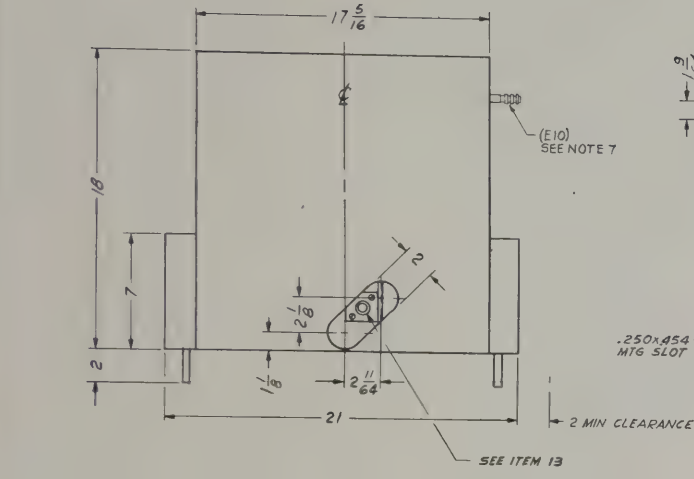
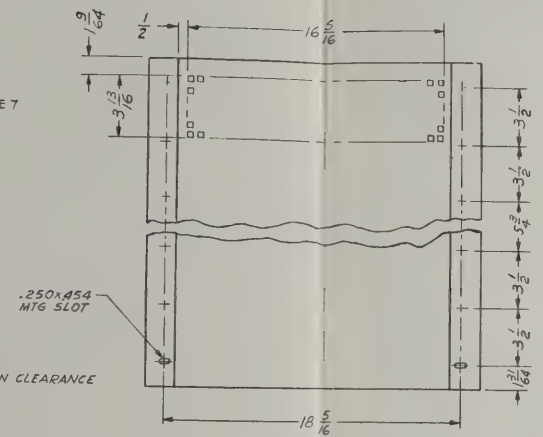
6. 120 VAC INPUT IS APPLIED TO TERMINALS 1 & 2 OF TB1 IF AUTO TRANSFORMER IS NOT SUPPLIED.
7. REMOVE E10 (50Ω TERMINATION) WHEN RADIO RELAY IS USED.

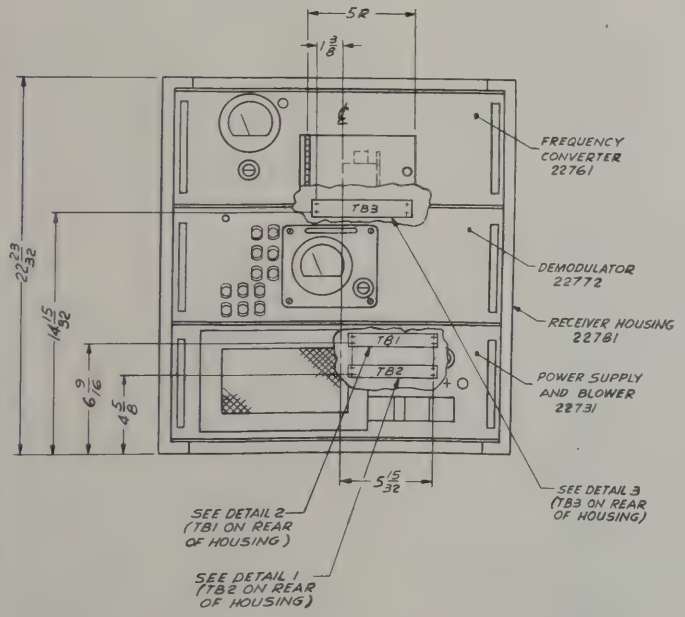
NOTES:
1. A - JUMPER - REL SUPPLY.
   B - DELAY LINE CAN BE SUBSTITUTED.
2. CP7, CP8, CP9 REL SUPPLIED.
3. REFERENCE DESIGNATIONS ARE ABBREVIATED. PREFIX THE DESIGNATIONS WITH THE UNIT NO.
4. CUSTOMER OPTION - TERMINATION DEPENDENT UPON SPECIFIC TERMINAL CONFIGURATION.
5. INPUT POWER TO THE EXCITER IS ARRANGED TO ACCEPT THE FOLLOWING:
   240 VAC AT TERMINALS 9 & 10 OF TB1.
   230 VAC AT TERMINALS 7 & 8 OF TB1.
   220 VAC AT TERMINALS 5 & 6 OF TB1.
   JUMPER BETWEEN 2 & 4 AND 1 & 3 ARE USED ONLY WHEN AUTO TRANSFORMER IS SUPPLIED.

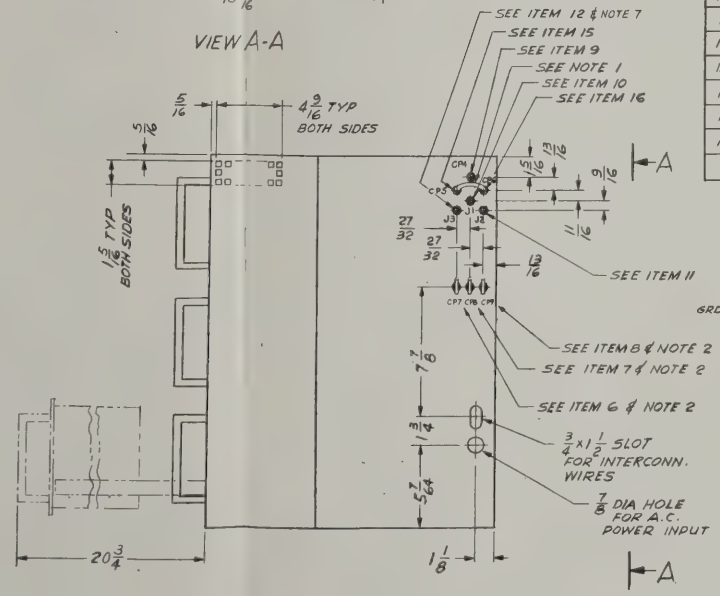
CABLES TO BE PROVIDED BY EQUIPMENT INSTALLING AGENCY

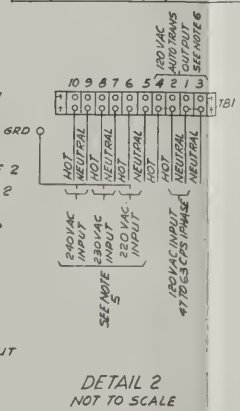
ITEM	FUNCTION	FROM		TO		WIRE OR CABLE	CABLE CONNECTION	
		UNIT	CONNECTOR	UNIT	CONNECTOR		ON RECEIVER	ON EQUIPMENT
1	ORDER WIRE OUTPUT 600Ω	RECEIVER	TB3 TERM 1,2,5	SEE NOTE 4	—	RG108A/U	BURNDY YAE 18-G43	—
2	SIGNAL STRENGTH RECORDER		TB3 TERM 6,7,8	SEE NOTE 4	—	RG108A/U	BURNDY YAE 18-G43	—
3	COMBINER RECORDER		TB3 TERM 9,10,11	SEE NOTE 4	—	RG108A/U	BURNDY YAE 18-G43	—
4	EXT ALARM DRY CONTACTS		TB2 TERM 1,2,3,4,5,6	SEE NOTE 4	—	6 # 18AWG	BURNDY YAE 18-Z2	—
5	PILOT INTER-CONNECT RELAY		TB2 TERM 7,8	SEE NOTE 4	—	2 # 18AWG	BURNDY YAE 18-Z2	—
6	BB COMBINER INTERCONNECT		CP7 DAGE 8002-1	COMPANION RECEIVER	CP7 DAGE 8002-1	RG 62/U	DAGE 8004-1	DAGE 8004-1
7	O.W. COMBINER INTERCONNECT		CP8 DAGE 8002-1	COMPANION RECEIVER	CP8 DAGE 8002-1	RG 62/U	DAGE 8004-1	DAGE 8004-1
8	PILOT REFLEX INTERCONNECT		CP9 DAGE 8002-1	COMPANION RECEIVER	CP9 DAGE 8002-1	RG 58/U	DAGE 8000-1	DAGE 8000-1
9	BASEBAND OUTPUT		CP4 DAGE 3269-1	SEE NOTE 4	—	RG 59B/U	UG 603A/U	—
10	MONITOR TO MC INPUT		J1 MICON 9084	SEE NOTE 4	—	RG 223/U	DAGE 8000-1	—
11	I.F. RECORDER OUTPUT		J2 MICON 9084	SEE NOTE 4	—	RG 58C/U	DAGE 8000-1	—
12	RADIO RELAY OUTPUT		J3 MICON 9084	TO EXC (FOR LOS OPERATION ONLY)	MICON 9084	RG 58C/U	DAGE 8000-1	DAGE 8000-1
13	RF INPUT		J1 TYPE N	SEE NOTE 4	—	—	—	—
14	DWP INP (120VAC 60CPS)		TB1 TERM 0,1,2	COMPANION RECEIVER	TB1 TERM 0,1,2	3 # 12AWG	BURNDY YAE 12-N1	BURNDY YAE 12-N1
15	FREQ CONVERTER 70MC OUTPUT		CP5 DAGE 3269-1	CUSTOMER DELAY LINE (WHEN REQD)	—	RG 214/U	UG 21D/U	—
16	DEMODULATOR 70MC INPUT	RECEIVER	CP6 DAGE 3269-1	CUSTOMER DELAY LINE (WHEN REQD)	—	RG 214/U	UG 21D/U	—











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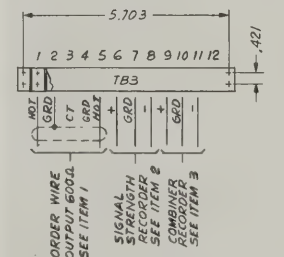

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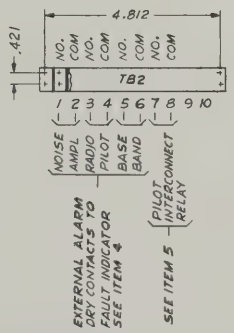

DETAIL 1
NOT TO SCALE

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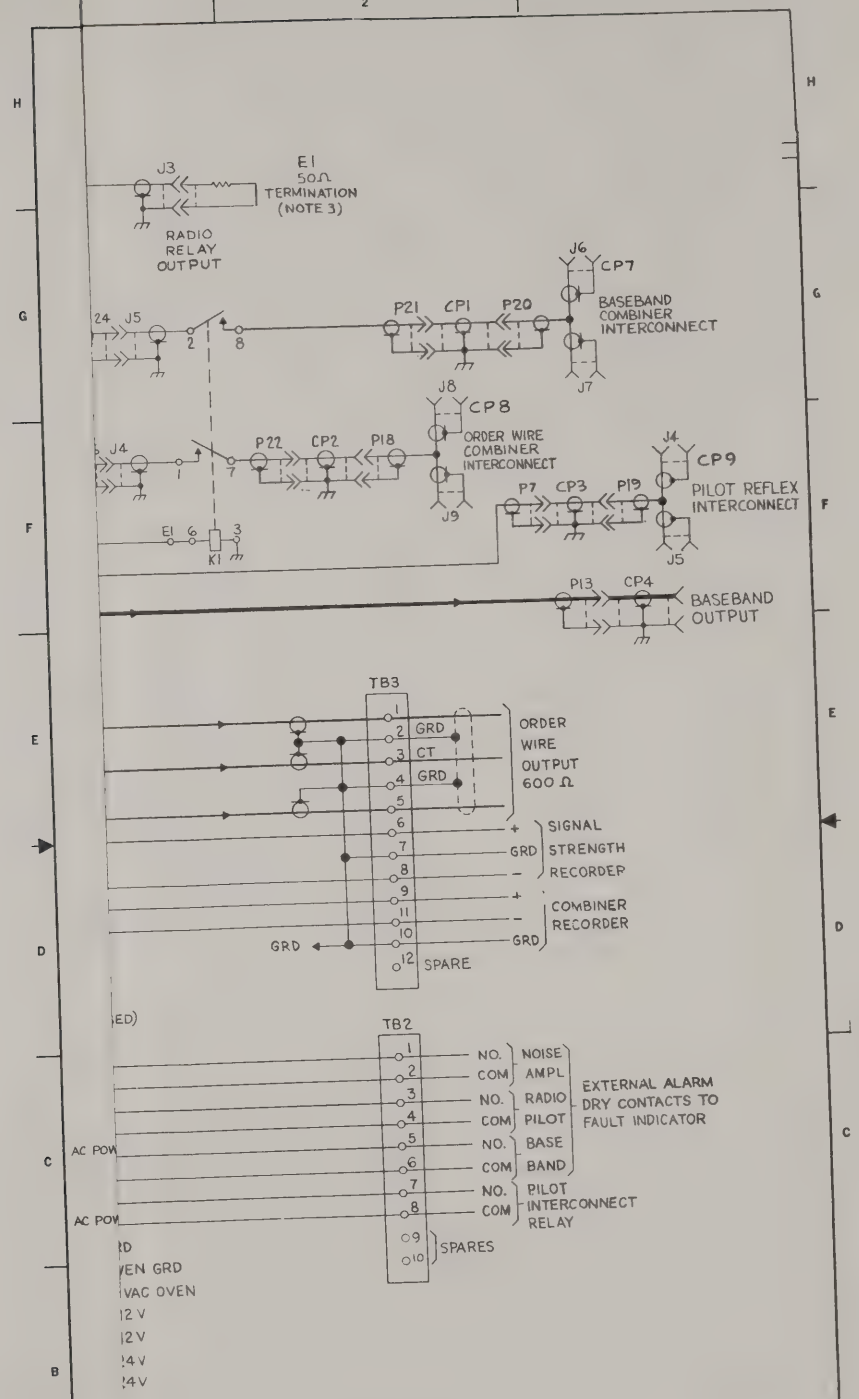
FIGURE 5-4. RECEIVER, INSTALLATION DIAGRAM, TYPE 1130A.


J3
E1
50Ω
TERMINATION
(NOTE 3)
RADIO
RELAY
OUTPUT
J6
CP7
BASEBAND
COMBINER
INTERCONNECT
J7
P21
CP1
P20
J5
J8
CP8
ORDER WIRE
COMBINER
INTERCONNECT
J9
J4
P22
CP2
P18
J4
CP9
PILOT REFLEX
INTERCONNECT
J5
P7
CP3
P19
E1
K1
P13
CP4
BASEBAND
OUTPUT
TB3
GRD
CT
GRD
ORDER
WIRE
OUTPUT
600Ω
SIGNAL
STRENGTH
RECORDER
COMBINER
RECORDER
SPARE
TB2
NOISE
AMPL
RADIO
PILOT
BASE
BAND
PILOT
INTERCONNECT
RELAY
EXTERNAL ALARM
DRY CONTACTS TO
FAULT INDICATOR
SPARES

1130-02

1130.

NOTES:

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. PREFIX THE DESIGNATION WITH UNIT NUMBER OR ASSEMBLY DESIGNATION OR BOTH.
2. AC JUNCTION BOX IS NOT PART OF RECEIVER AND IS SHOWN FOR REFERENCE ONLY.
3. REMOVE TERMINATION WHEN RADIO RELAY OUTPUT IS USED.

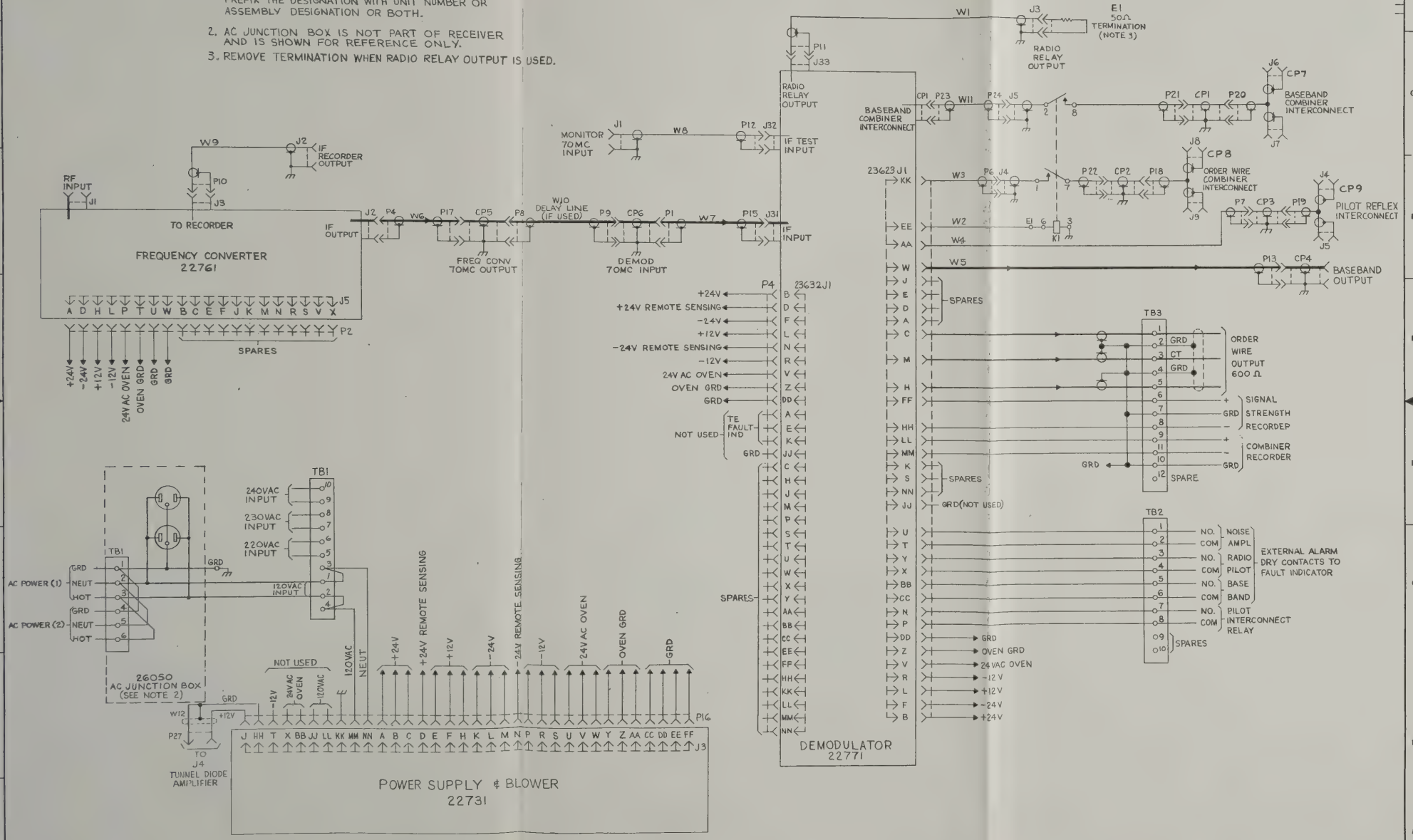
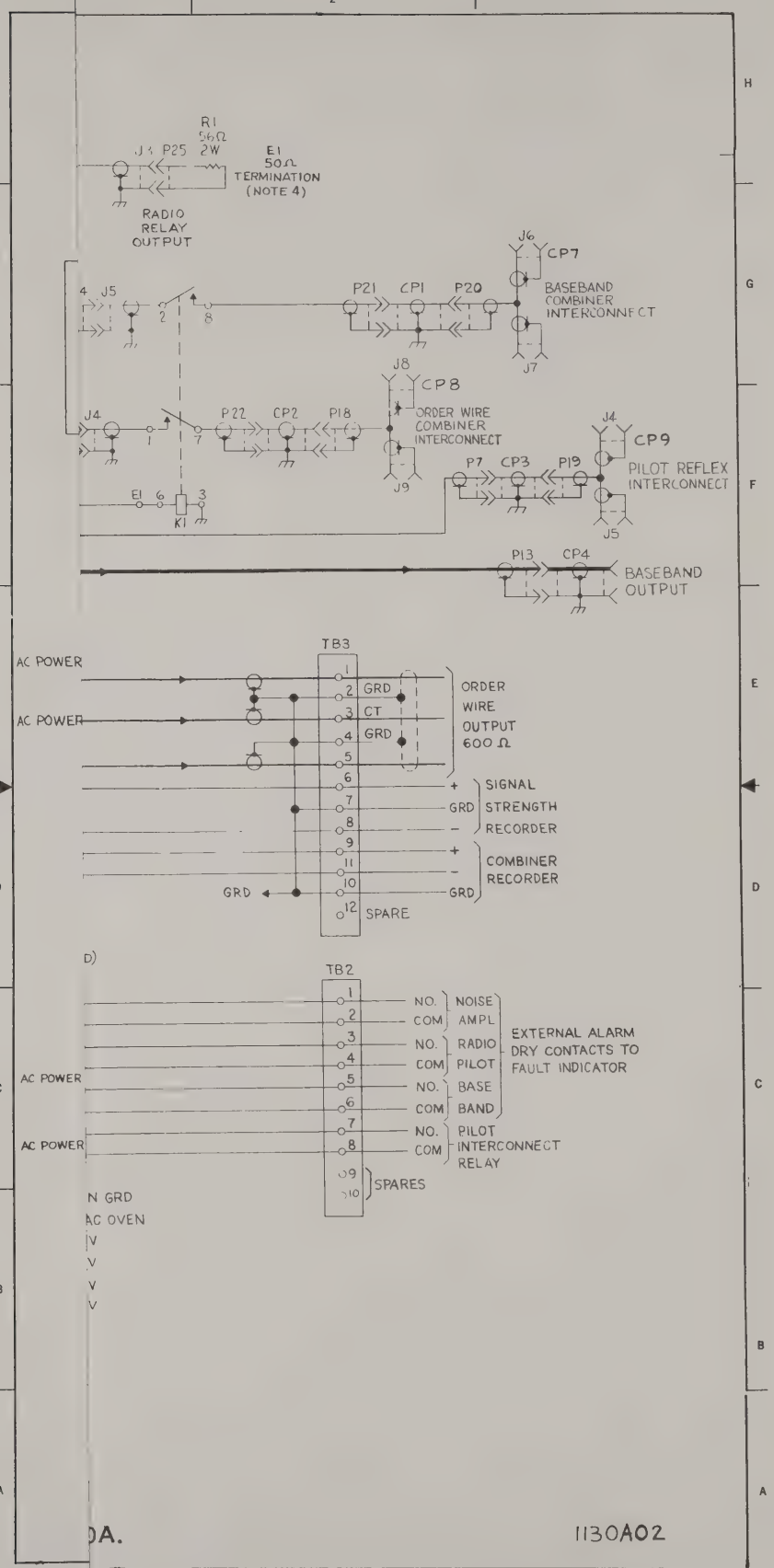


FIGURE 5—5. RECEIVER HOUSING, SCHEMATIC DIAGRAM, TYPE 1130.

1130-02


R1
56Ω
2W
J3 P25
E1
50Ω
TERMINATION
(NOTE 4)
RADIO
RELAY
OUTPUT
J6
CP7
BASEBAND
COMBINER
INTERCONNECT
J7
P21
CP1
P20
J5
J8
CP8
ORDER WIRE
COMBINER
INTERCONNECT
J9
J4
P22
CP2
P18
J4
CP9
PILOT REFLEX
INTERCONNECT
J5
P7
CP3
P19
E1
K1
P13
CP4
BASEBAND
OUTPUT
TB3
AC POWER
AC POWER
GRD
CT
GRD
ORDER
WIRE
OUTPUT
600Ω
SIGNAL
STRENGTH
RECORDER
COMBINER
RECORDER
GRD
SPARE
TB2
NO.
COM
NOISE
AMPL
RADIO
PILOT
BASE
BAND
EXTERNAL ALARM
DRY CONTACTS TO
FAULT INDICATOR
AC POWER
AC POWER
PILOT
INTERCONNECT
RELAY
SPARES
N GRD
AC OVEN
V
V
V
V

1130A02

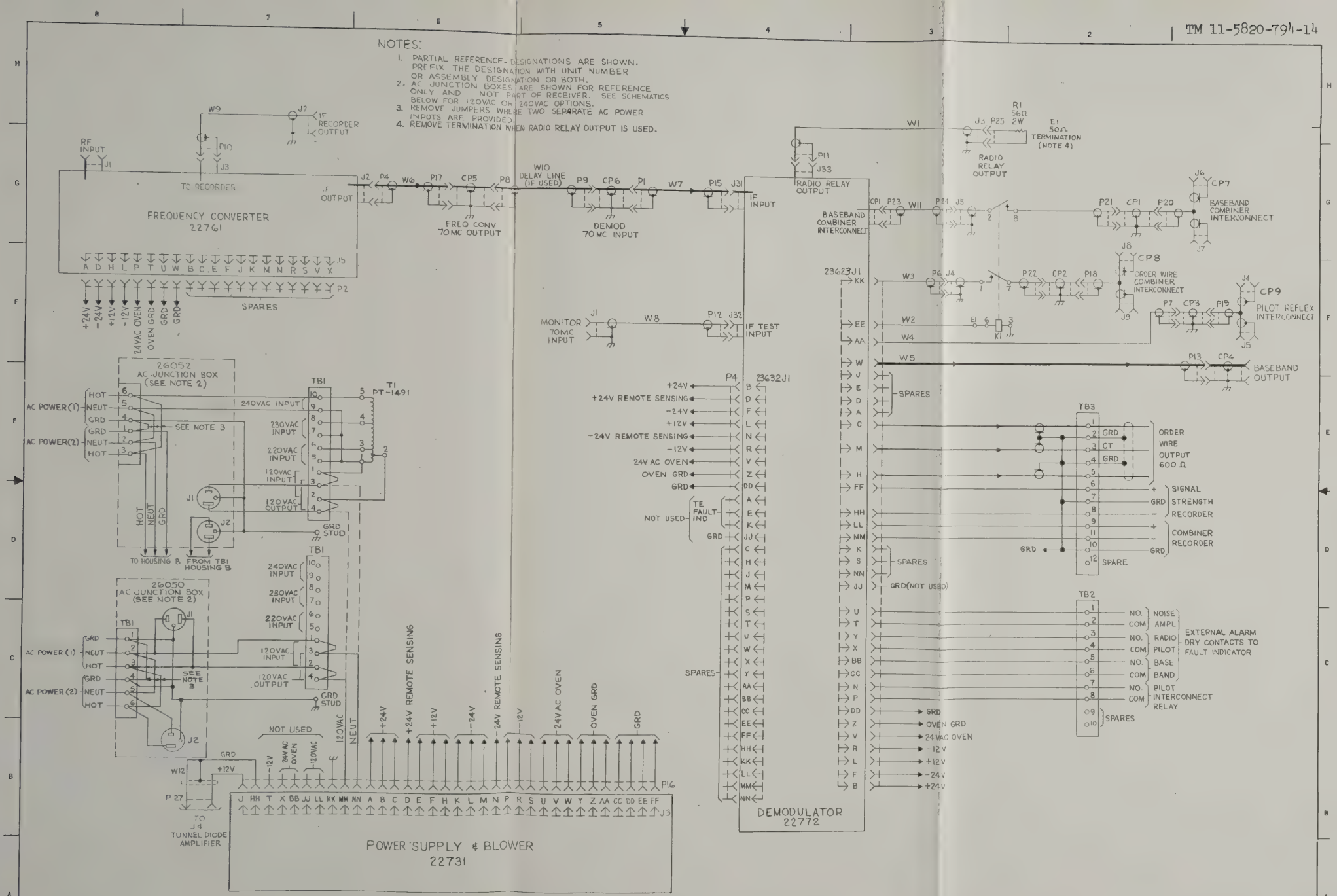
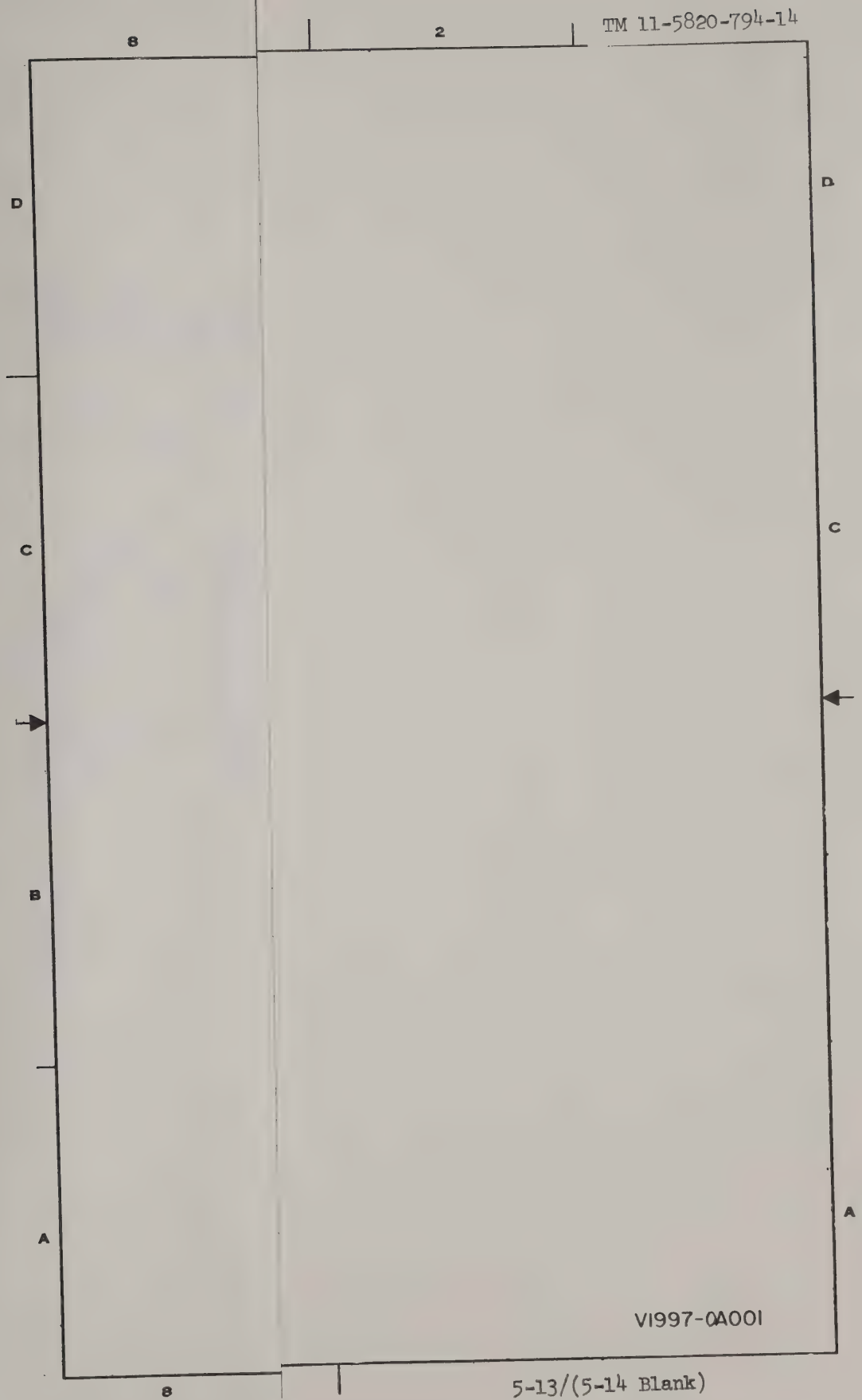
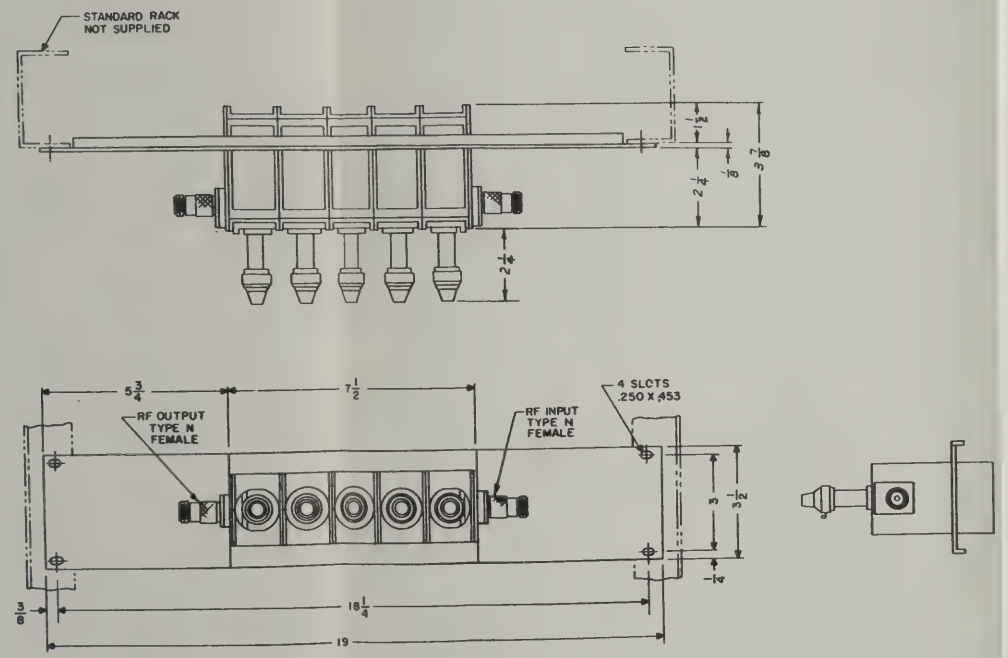


FIGURE 5-6. RECEIVER HOUSING, SCHEMATIC DIAGRAM, TYPE 1130A.

1130A02



V1997-0A001



V1997-0A001

FIGURE 5-7. RF PRESELECTOR, INSTALLATION DIAGRAM.

NOTE:
REFERENCE DESIGNATIONS ARE ABBREVIATED,
PREFIX THE DESIGNATION WITH THE UNIT NO. 9

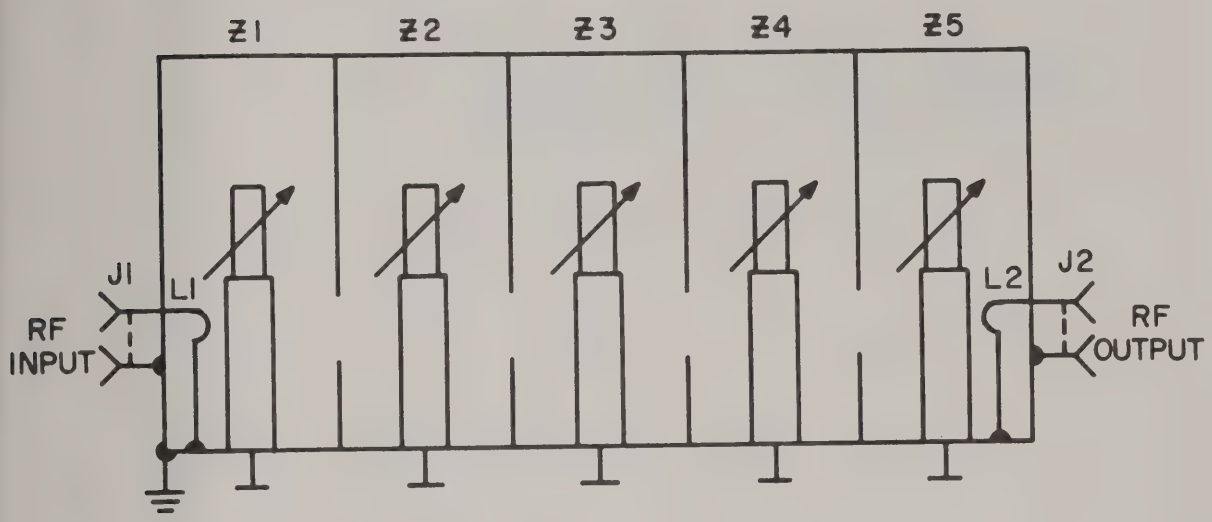
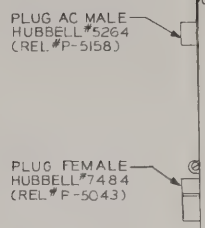


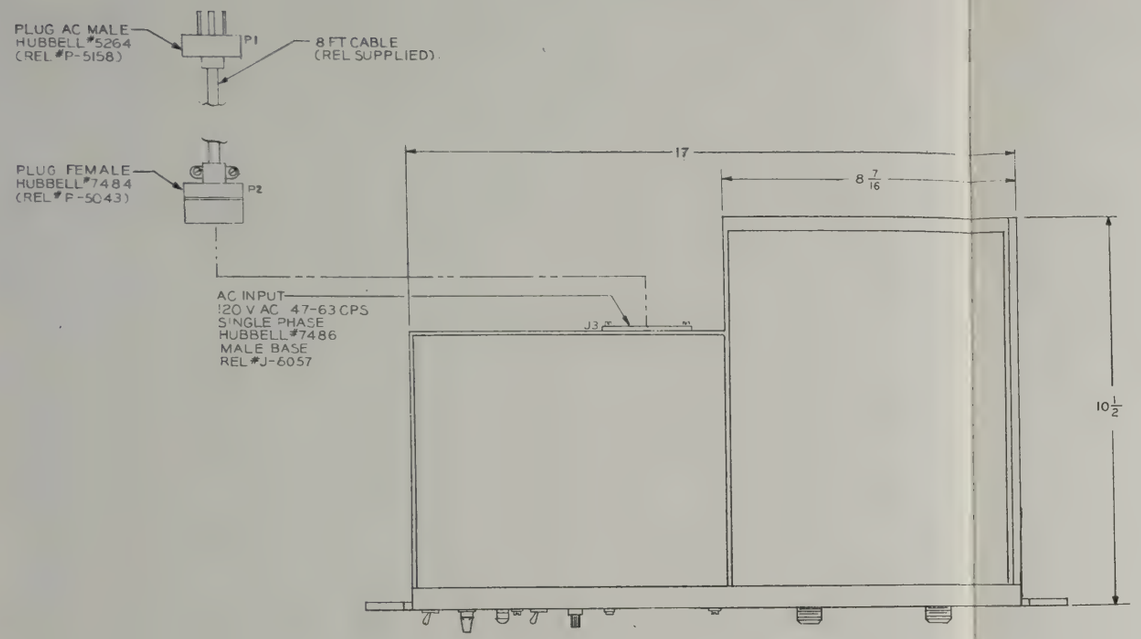
FIGURE 5—8. RF PRESELECTOR, SCHEMATIC DIAGRAM.



) BE PROVIDED BY EQUIPMENT INSTALLING AGENCY

FROM		TO		WIRE OR CABLE	CABLE CONNECTION	
	CONNECTOR	UNIT	CONNECTOR		ON TUNNEL DIODE END	ON EQUIPMENT
	TYPE "N" FEMALE J1	SEE NOTE 2		RG214/U	TYPE "N" MALE	
	TYPE "N" FEMALE J2	SEE NOTE 2		RG214/U	TYPE "N" MALE	

1133-11

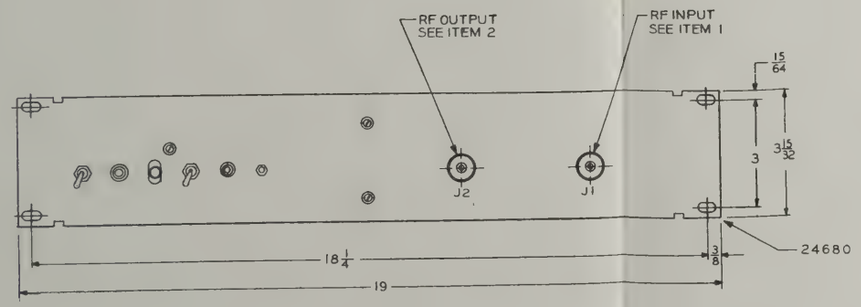


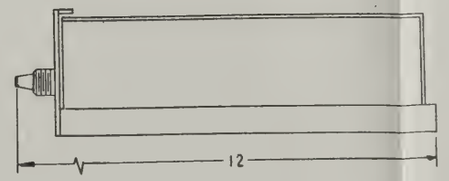
NOTES:

1. REFERENCE DESIGNATIONS ARE ABBREVIATED PREFIX THE DESIGNATIONS WITH THE UNIT NO. 8
2. CUSTOMER OPTION - TERMINATION DEPENDENT UPON SPECIFIC TERMINAL CONFIGURATION.

CABLES TO BE PROVIDED BY EQUIPMENT INSTALLING AGENCY

ITEM	FUNCTION	FROM		TO		WIRE OR CABLE	CABLE CONNECTION	
		UNIT	CONNECTOR	UNIT	CONNECTOR		ON TUNNEL DIODE END	ON EQUIPMENT
1	RF INPUT	TDA	TYPE 'N' FEMALE J1	SEE NOTE 2		RG214/U	TYPE 'N' MALE	
2	RF OUTPUT	TDA	TYPE 'N' FEMALE J2	SEE NOTE 2		RG214/U	TYPE 'N' MALE	
3								
4								





1133-11

FIGURE 5—9. TUNNEL DIODE AMPLIFIER, INSTALLATION DIAGRAM.

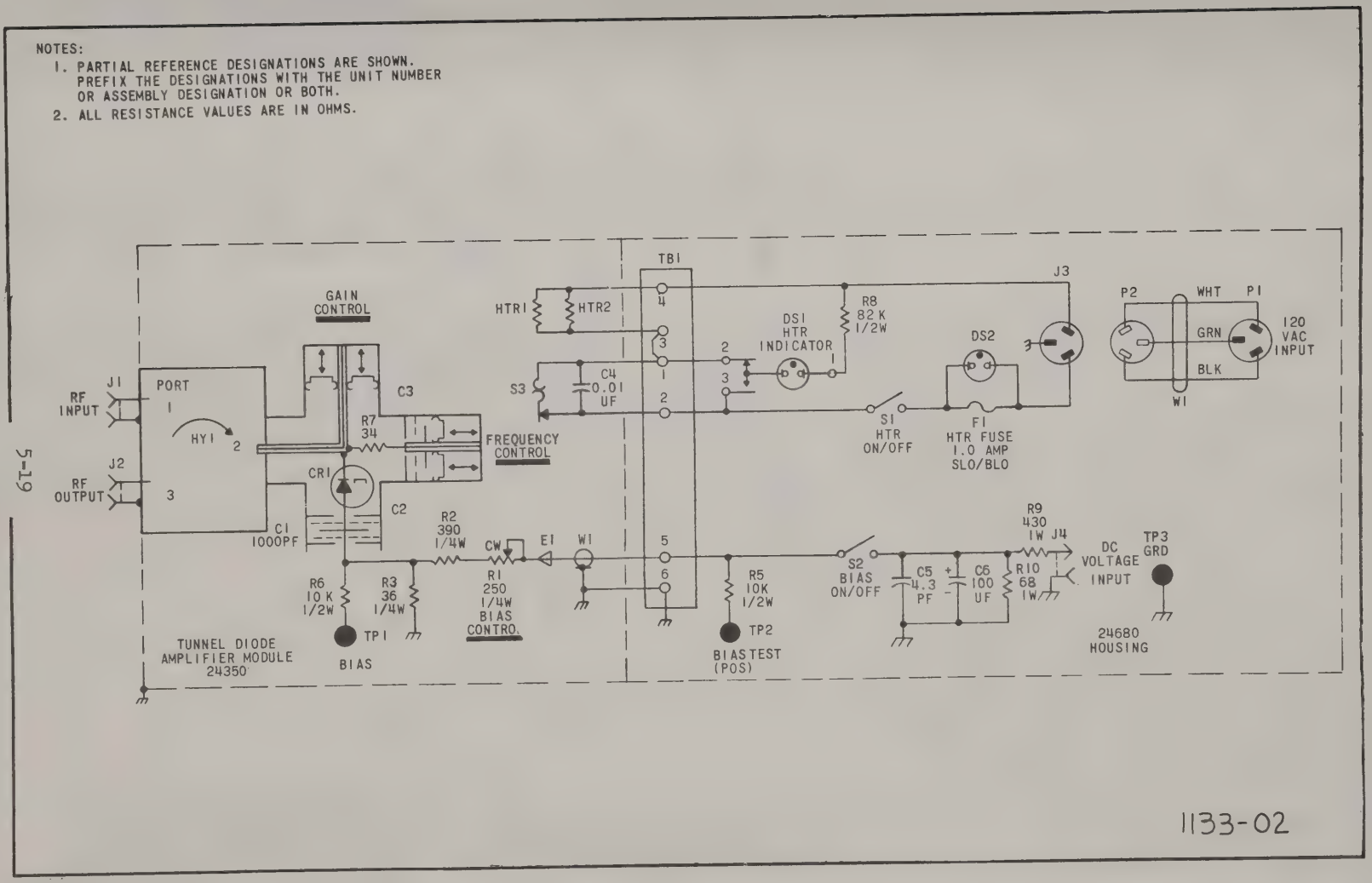
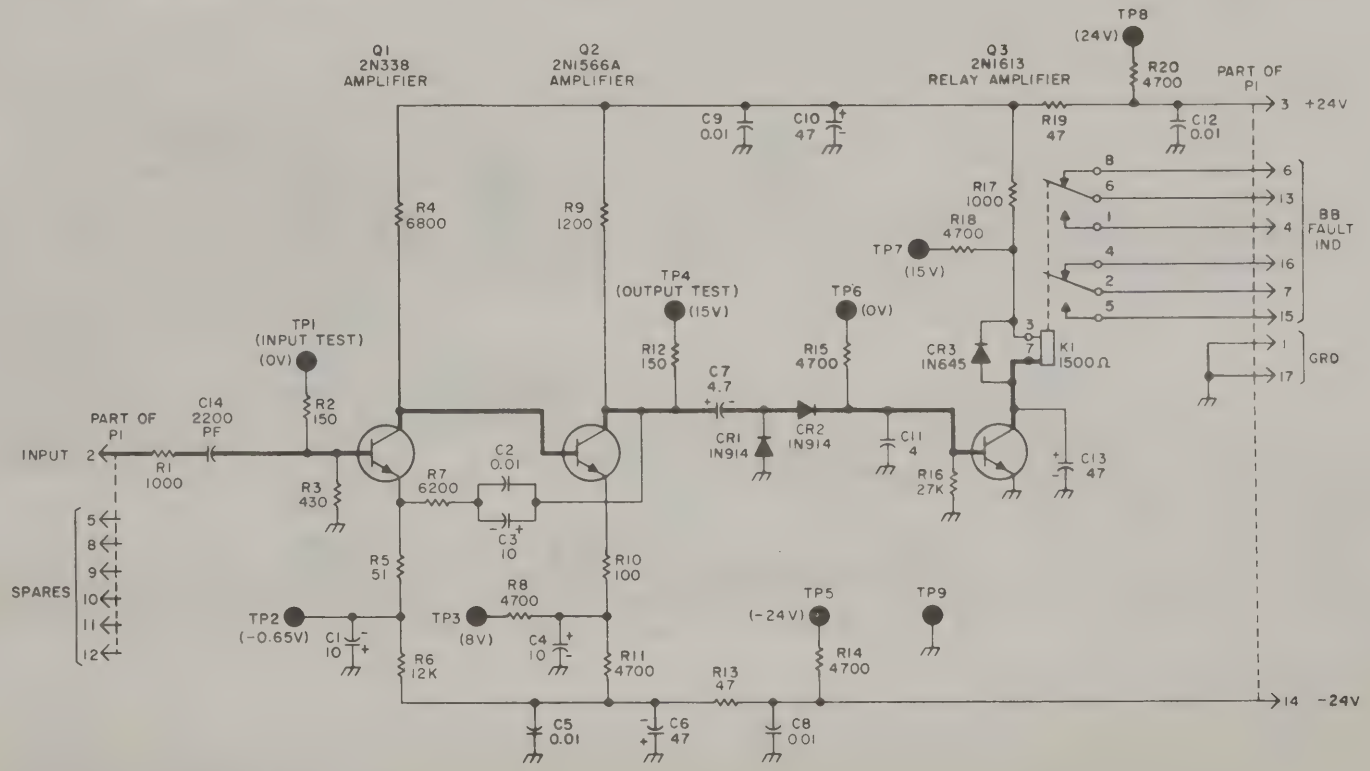


FIGURE 5—10. TUNNEL DIODE AMPLIFIER, SCHEMATIC DIAGRAM.

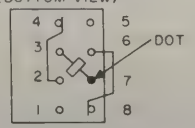
TM 11-5820-794-14

NOTES
1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. PREFIX THE DESIGNATION WITH UNIT NUMBER OR ASSEMBLY DESIGNATION OR BOTH.
2. UNLESS OTHERWISE INDICATED ALL RESISTANCE VALUES ARE IN OHMS, 1/2 WATT, ALL CAPACITANCE VALUES ARE IN UF.
3. RELAY SHOWN IN DE-ENERGIZED POSITION.
4. ALL RESISTANCE MEASUREMENTS ARE TAKEN WITH ALL EXTERNAL CONNECTIONS REMOVED.
5. ALL VOLTAGE AND RESISTANCE MEASUREMENTS ARE NOMINAL AND ARE TAKEN BETWEEN SPECIFIED PIN AND TP9 WITH RCA VTVM TYPE WV98C OR EQUIVALENT.



		EMITTER	BASE	COLL
Q1	V	-0.65	0	10
	R	50K(b)	430(a)	∞
Q2	V	8	10	15
	R	35K(b)	∞	∞
Q3	V	0	0	15
	R		6000(b)	∞

BASING DIAGRAM FOR K1 (BOTTOM VIEW)



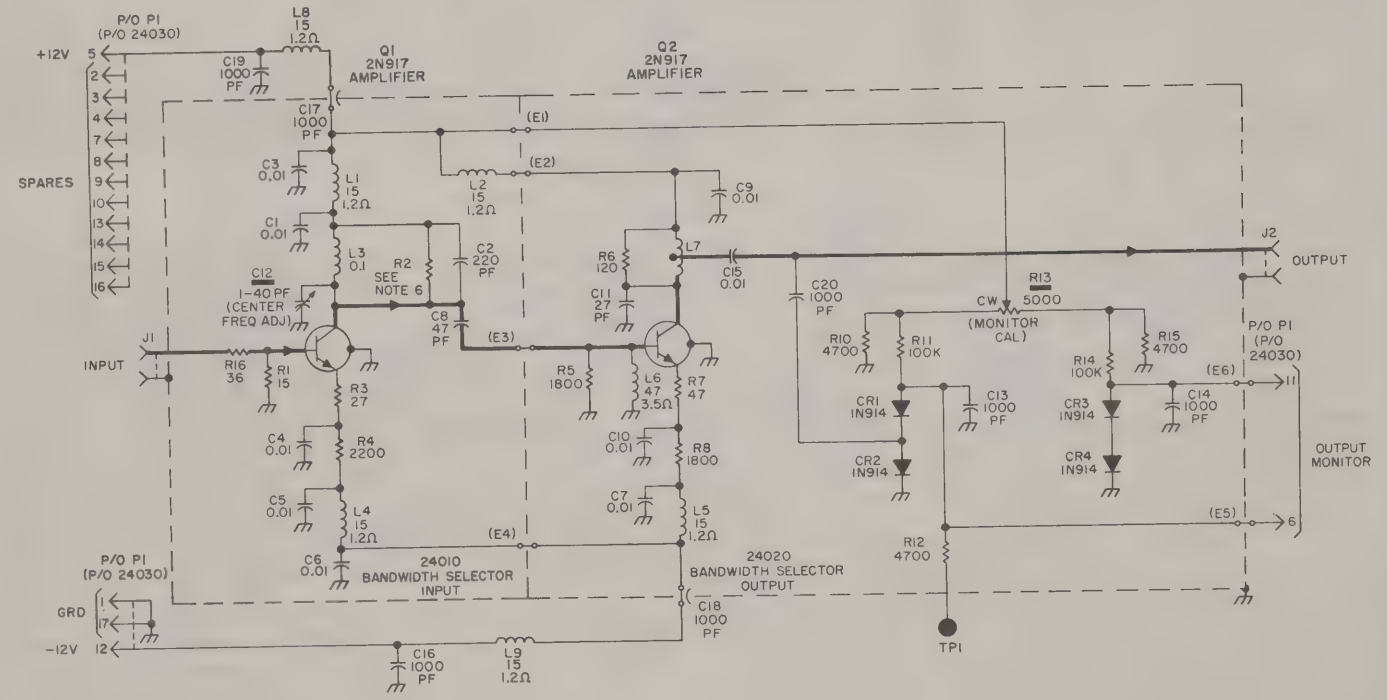
a-MEASURED ON RX100 RANGE
b-MEASURED ON RX1000 RANGE

FIGURE 5-11. ALARM AMPLIFIER, SCHEMATIC DIAGRAM.

23582-02

NOTES

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. PREFIX THE DESIGNATION WITH UNIT NUMBER OR ASSEMBLY DESIGNATION OR BOTH.
2. UNLESS OTHERWISE INDICATED: ALL RESISTANCE VALUES ARE IN OHMS, 1/4 W, ALL CAPACITANCE VALUES ARE IN UF, ALL INDUCTANCE VALUES ARE IN UH.
3. DC RESISTANCE OF COILS LESS THAN ONE OHM NOT SHOWN.
4. ALL VOLTAGE AND RESISTANCE MEASUREMENTS TAKEN BETWEEN SPECIFIED PIN AND GROUND WITH RCA VTVM TYPE WV98A OR EQUIVALENT.
5. ALL RESISTANCE MEASUREMENTS TAKEN WITH ALL EXTERNAL CONNECTIONS REMOVED.
6. BANDWIDTH SELECTOR RESISTOR MAY BE 2000Ω OR 2400 FACTORY ADJUST.



		EMIT	BASE	COLL
Q1	V	-0.74	0	12
	R	∞	16 (b)	3.4K(d)
Q2	V	-0.73	0	12
	R	∞	3 (a)	3.5K(d)

a-MEASURED ON R x 1 RANGE

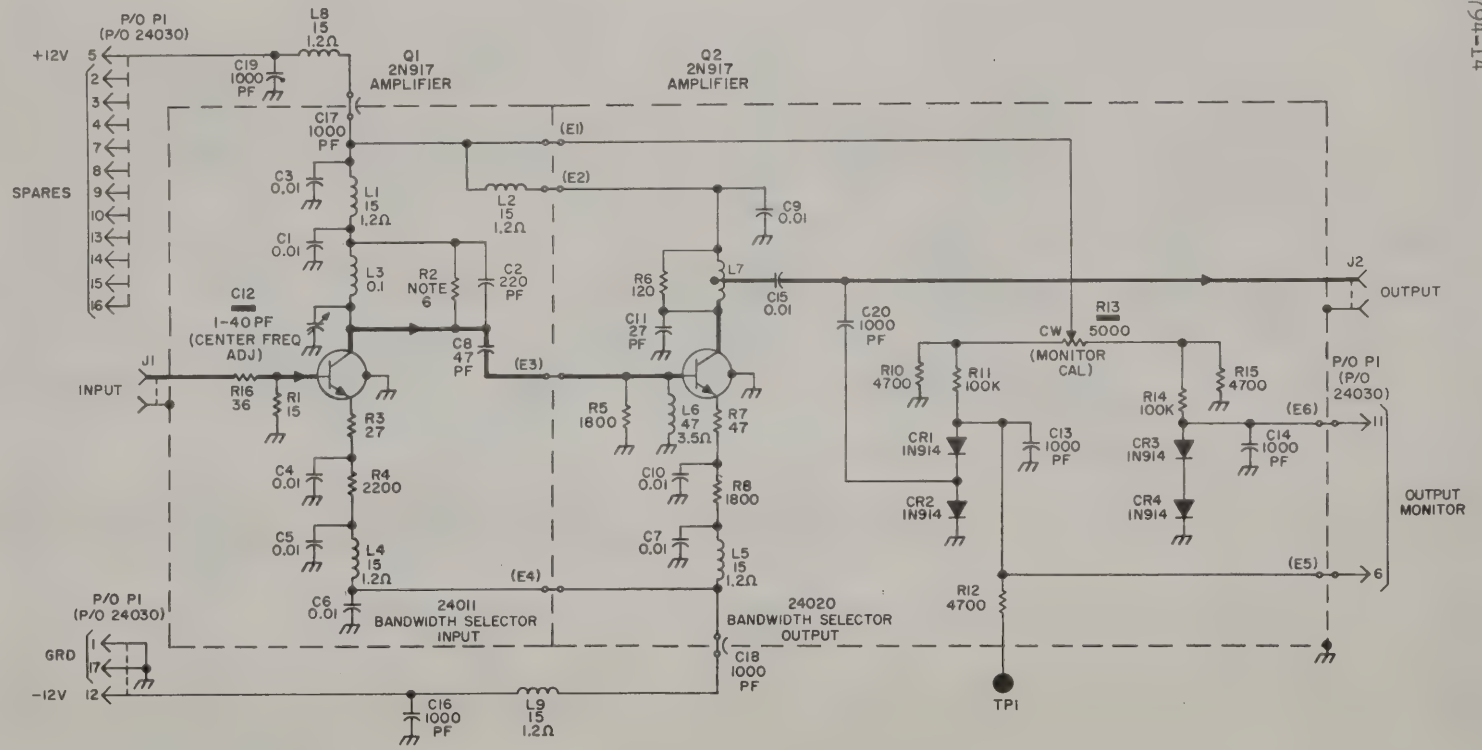
b-MEASURED ON R x 10 RANGE

d-MEASURED ON R x 1000 RANGE

FIGURE 5-12. BANDWIDTH SELECTOR, 72 CHANNELS. SCHEMATIC DIAGRAM, TYPE 1130.

NOTES

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. PREFIX THE DESIGNATION WITH UNIT NUMBER OR ASSEMBLY DESIGNATION OR BOTH.
2. UNLESS OTHERWISE INDICATED: ALL RESISTANCE VALUES ARE IN OHMS, 1/4 W, ALL CAPACITANCE VALUES ARE IN UF, ALL INDUCTANCE VALUES ARE IN UH.
3. DC RESISTANCE OF COILS LESS THAN ONE OHM NOT SHOWN.
4. ALL VOLTAGE AND RESISTANCE MEASUREMENTS TAKEN BETWEEN SPECIFIED PIN AND GROUND WITH RCA VTVM TYPE WV98A OR EQUIVALENT.
5. ALL RESISTANCE MEASUREMENTS TAKEN WITH ALL EXTERNAL CONNECTIONS REMOVED.
6. BANDWIDTH SELECTOR RESISTOR MAY BE 750Ω OR 820Ω FACTORY ADJUST.

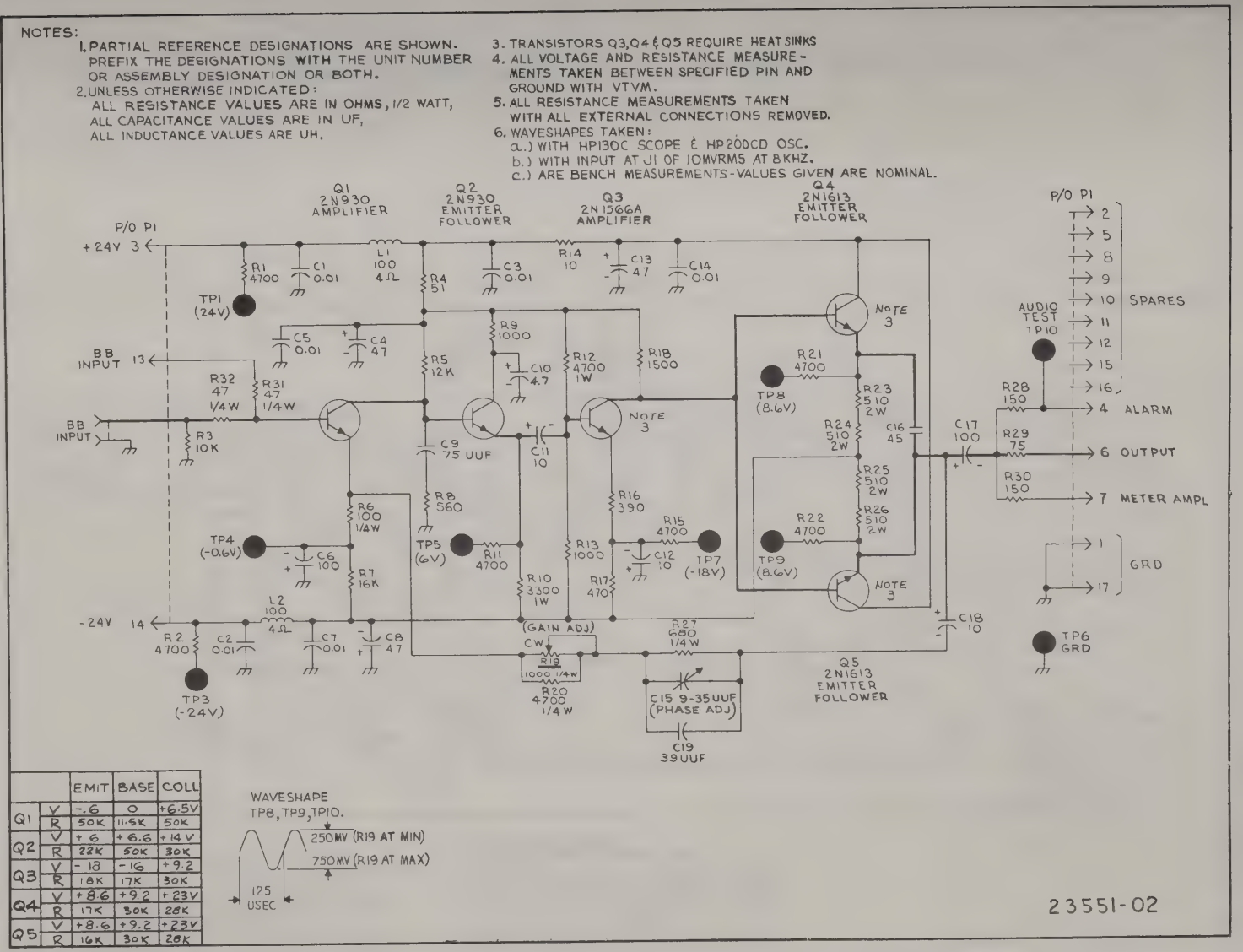


		EMIT	BASE	COLL
Q1	V	-0.74	0	12
	R	∞	16 (b)	3.4K(d)
Q2	V	-0.73	0	12
	R	∞	3 (a)	3.5K(d)

a-MEASURED ON R x 1 RANGE
b-MEASURED ON R x 10 RANGE
d-MEASURED ON R x 1000 RANGE

FIGURE 5-13. BANDWIDTH SELECTOR, 132 CHANNELS, SCHEMATIC DIAGRAM, TYPE 1130.

24081-02

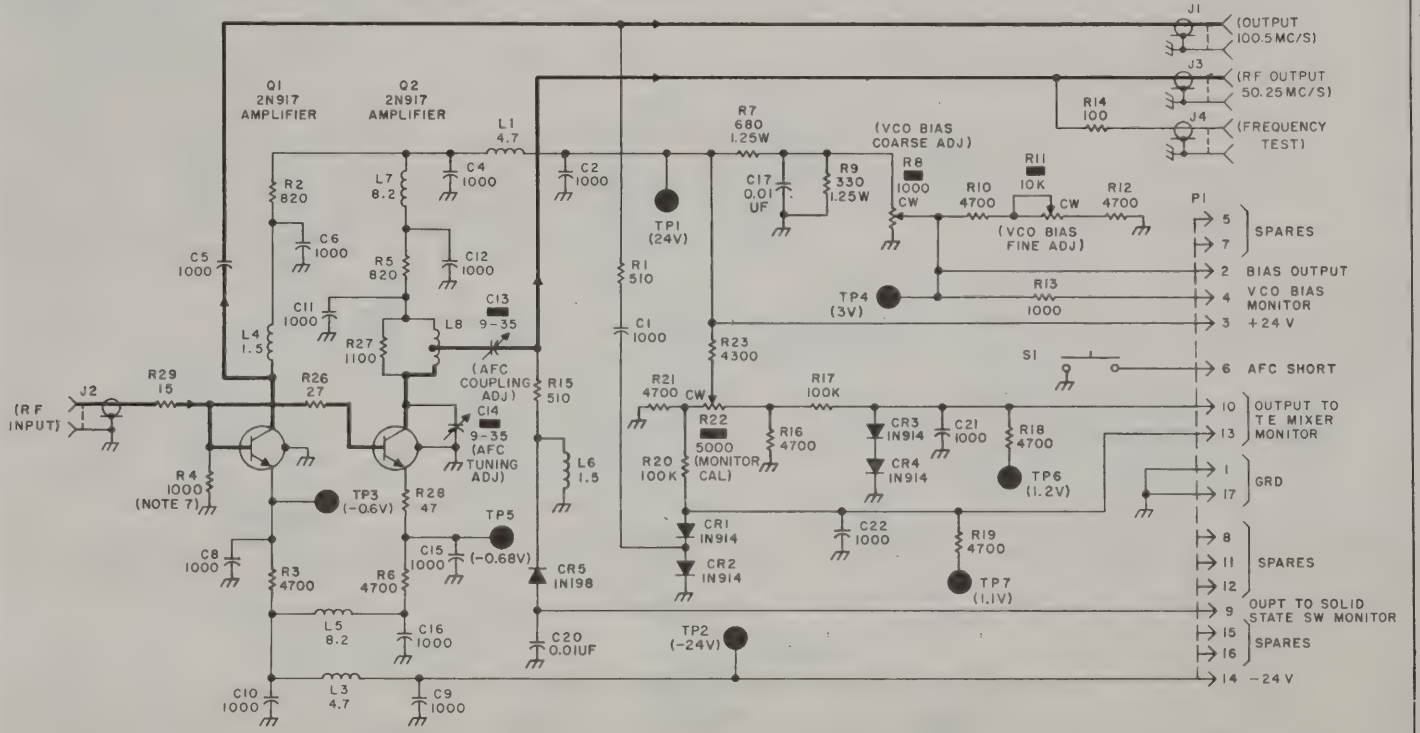


		EMIT	BASE	COLL
Q1	V	-.6	0	+6.5V
	R	50K	11.5K	50K
Q2	V	+6	+6.6	+14V
	R	22K	50K	30K
Q3	V	-18	-16	+9.2
	R	18K	17K	30K
Q4	V	+8.6	+9.2	+23V
	R	17K	30K	28K
Q5	V	+8.6	+9.2	+23V
	R	16K	30K	28K

FIGURE 5—14. BASEBAND AMPLIFIER, SCHEMATIC DIAGRAM.

NOTES:

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. PREFIX THE DESIGNATION WITH THE UNIT NUMBER OR ASSEMBLY DESIGNATION OR BOTH.
2. UNLESS OTHERWISE INDICATED:
   ALL RESISTANCE VALUES ARE IN OHMS, 1/4 W.
   ALL CAPACITANCE VALUES ARE IN UUF.
   ALL INDUCTANCE VALUES ARE IN UH.
3. ITEMS IN PARENTHESIS ARE FOR REFERENCE ONLY AND ARE NOT NECESSARILY STENCILED.
4. ALL VOLTAGE AND RESISTANCE MEASUREMENTS ARE NOMINAL AND ARE TAKEN BETWEEN SPECIFIED PIN AND GROUND WITH RCA VTVM TYPE WV98A OR EQUIVALENT.
5. ALL RESISTANCE MEASUREMENTS ARE TAKEN WITH ALL EXTERNAL CONNECTIONS REMOVED.
6. DC RESISTANCE OF COILS LESS THAN ONE OHM NOT SHOWN.
7. FOR PROJ. 758-252 CHANNEL CAPACITY, R4 CHANGES TO 820 Ω.



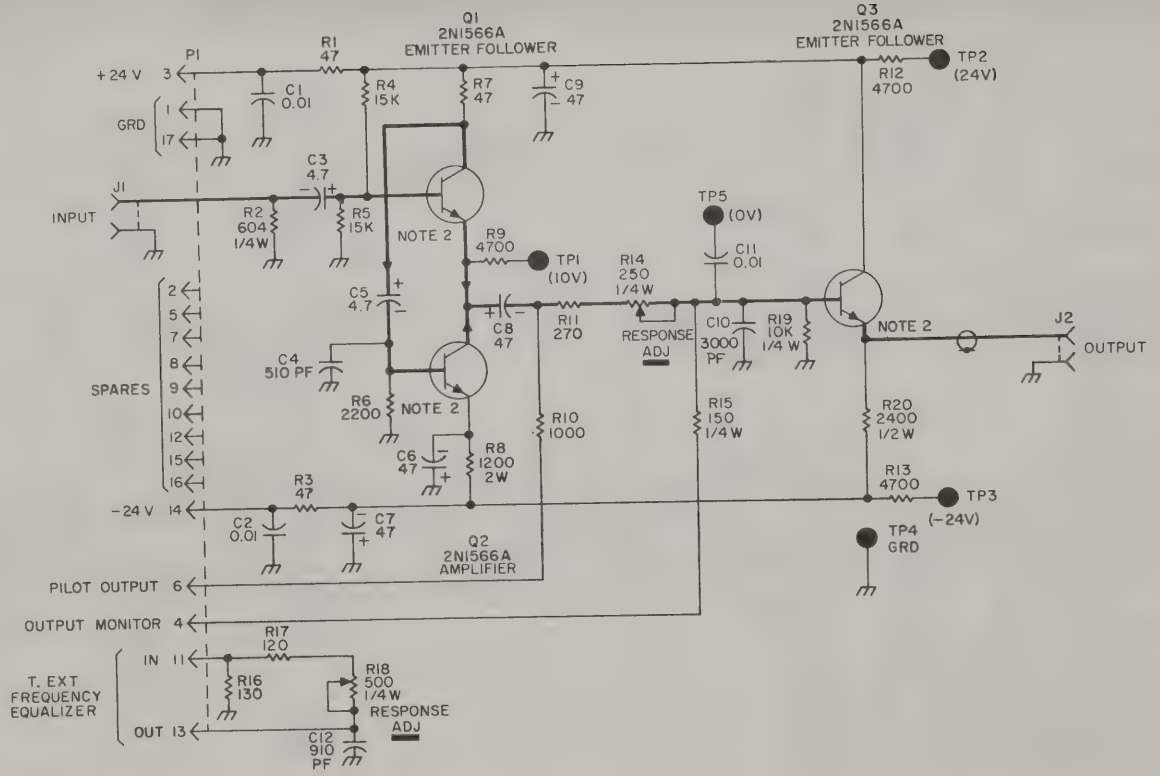
		EMIT	BASE	COLL
Q1	V	-0.6	0	20
	R	∞	38(a)	1650(b)
Q2	V	-0.68	0	20
	R	∞	63(a)	1650(b)

a- MEASURED ON RX10 RANGE
b- MEASURED ON RX100 RANGE

23450-02

FIGURE 5-15. BUFFER AMPLIFIER, SCHEMATIC DIAGRAM, TYPE 1130.

NOTES:
1. UNLESS OTHERWISE INDICATED ALL RESISTANCE VALUES ARE IN OHMS, 1/2 WATTS. ALL CAPACITANCE VALUES ARE IN UF
2. Q1, Q2, AND Q3 REQUIRE HEAT SINKS.
3. ALL VOLTAGE AND RESISTANCE MEASUREMENTS TAKEN BETWEEN SPECIFIED PIN AND GROUND WITH VTVM
4. ALL RESISTANCE MEASUREMENTS TAKEN WITH ALL EXTERNAL CONNECTIONS REMOVED.



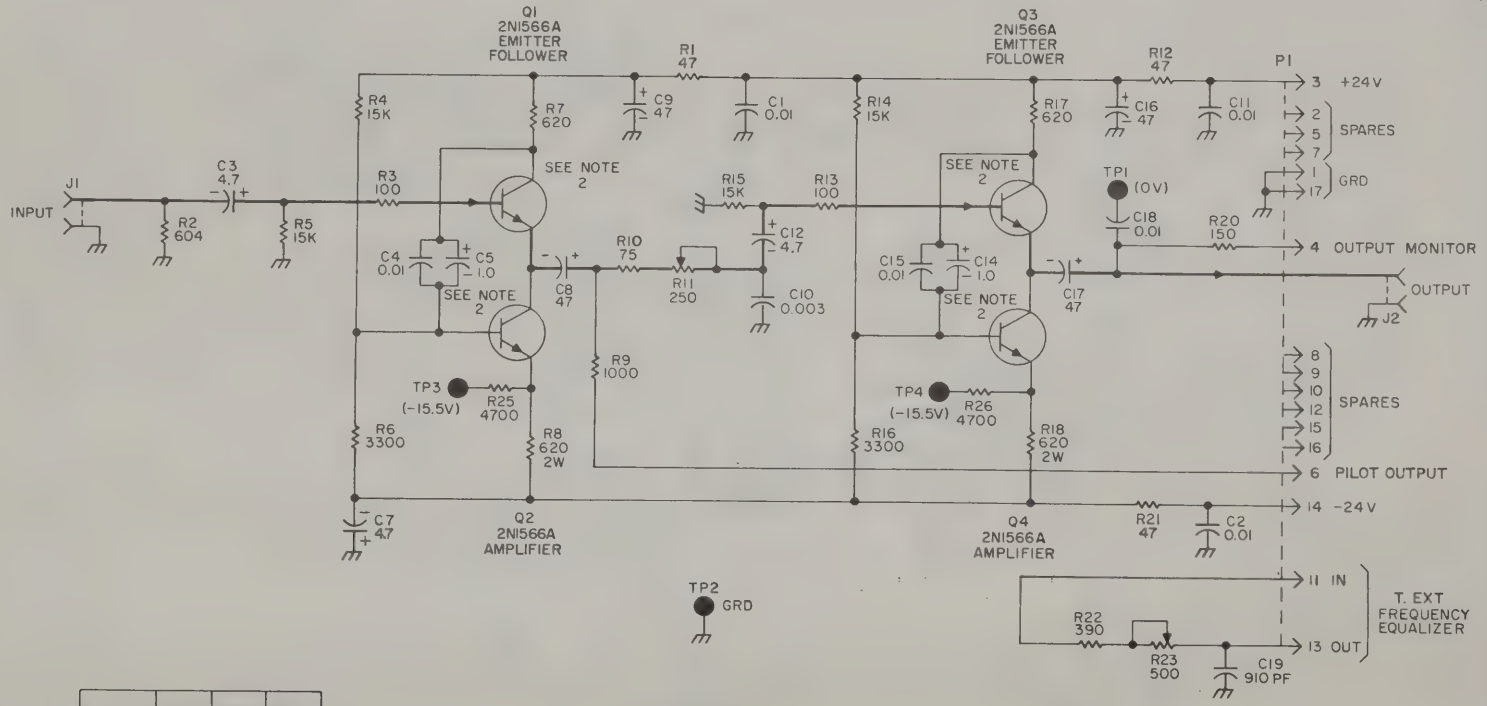
		EMIT	BASE	COLL
Q3	V	-1.16	-0.45	24
	R	50K	10K	35K
Q2	V	-1.12	-0.4	10
	R	35K	2.4K	∞
Q1	V	10	10.5	21.5
	R	∞	15K	33K

MEASURED ON RX1000 SCALE

23495-02

FIGURE 5-16. CHANNEL CAPACITY SELECTOR, 72 CHANNELS, SCHEMATIC DIAGRAM.

NOTES:
1. UNLESS OTHERWISE INDICATED ALL RESISTANCE VALUES ARE IN OHMS, 1/4 WATT, ALL CAPACITANCE VALUES ARE IN UF.
2. Q1,Q2,Q3,Q4 REQUIRE HEAT SINKS.
3. ALL VOLTAGE AND RESISTANCE MEASUREMENTS TAKEN BETWEEN SPECIFIED PIN AND GROUND WITH VTVM.
   ALL RESISTANCE MEASUREMENTS TAKEN WITH ALL EXTERNAL CONNECTIONS REMOVED.



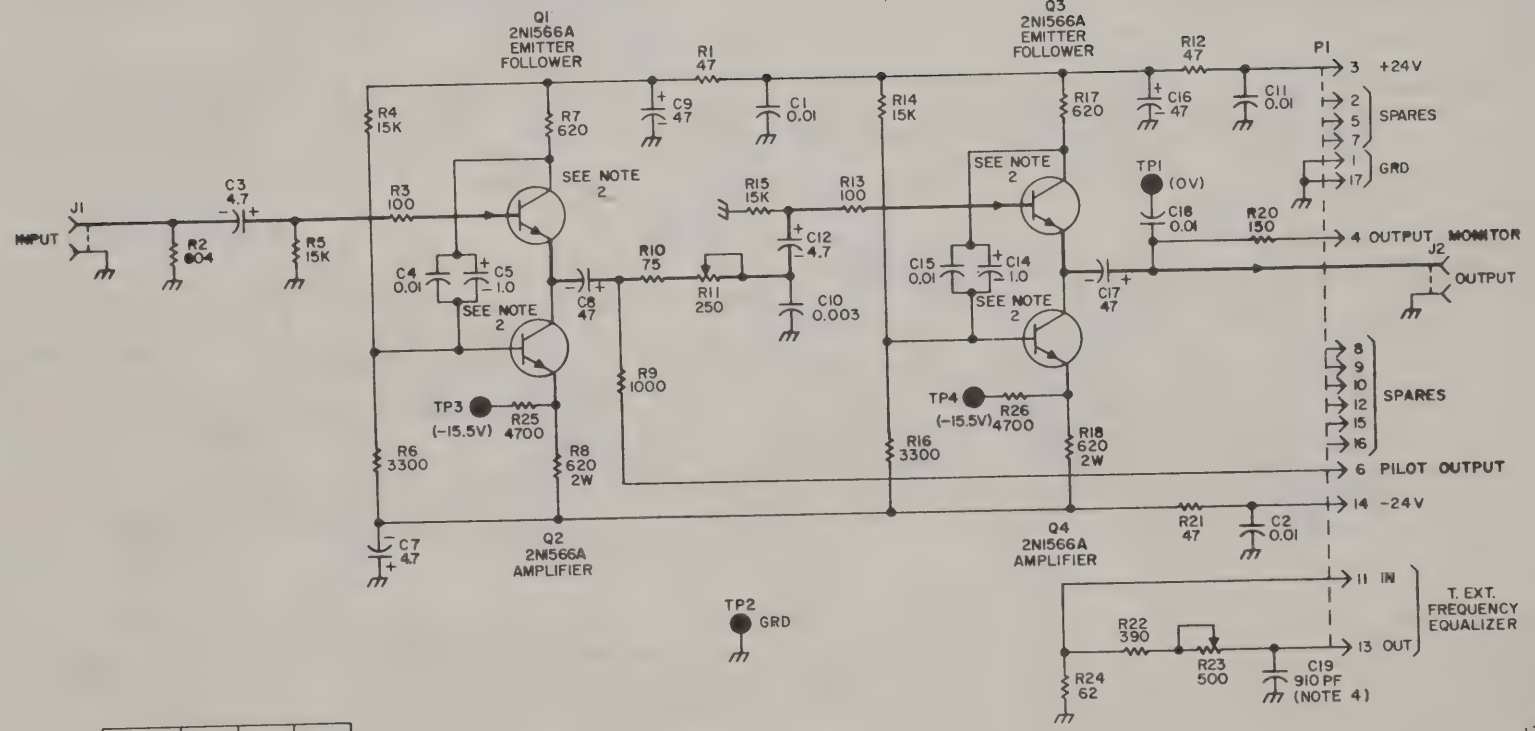
		EMIT	BASE	COLL
Q1	V	-1.5	-0.9	15
	R	∞	14K	∞
Q2	V	-15.5	-14.5	-1.5
	R	∞	∞	∞
Q3	V	-2	-1.4	15
	R	∞	14K	∞
Q4	V	-15.5	-14.5	-2
	R	∞	∞	∞

MEASURED ON RX 1000 RANGE

23494-02

FIGURE 5-17. CHANNEL CAPACITY SELECTOR, 132 CHANNELS, SCHEMATIC DIAGRAM.

NOTES:
1. UNLESS OTHERWISE INDICATED
   ALL RESISTANCE VALUES ARE IN OHMS, 1/4 WATT,
   ALL CAPACITANCE VALUES ARE IN UF.
2. Q1,Q2,Q3,Q4 REQUIRE HEAT SINKS.
3. ALL VOLTAGE AND RESISTANCE MEASUREMENTS TAKEN BETWEEN SPECIFIED PIN AND GROUND WITH VTVM.
   ALL RESISTANCE MEASUREMENTS TAKEN WITH ALL EXTERNAL CONNECTIONS REMOVED.
4. FOR PROJ 758-252 CHANNEL CAPACITY, C19 CHANGES TO 390PF.



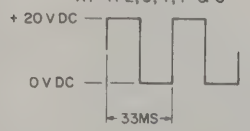
		EMIT	BASE	COLL
Q1	V	-1.5	-0.9	15
	R	∞	14K	∞
Q2	V	-15.5	-14.5	-1.5
	R	∞	∞	∞
Q3	V	-2	-1.4	15
	R	∞	14K	∞
Q4	V	-15.5	-14.5	-2
	R	∞	∞	∞

MEASURED ON RX1000 RANGE

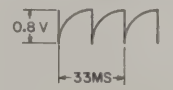
FIGURE 5-18 CHANNEL CAPACITY SELECTOR, 252 CHANNELS, SCHEMATIC DIAGRAM, TYPE 1130A. 23492-02

TM 11-5820-794-14

TYPICAL WAVESHAPE AT TP2, 3, 4, 7 & 8

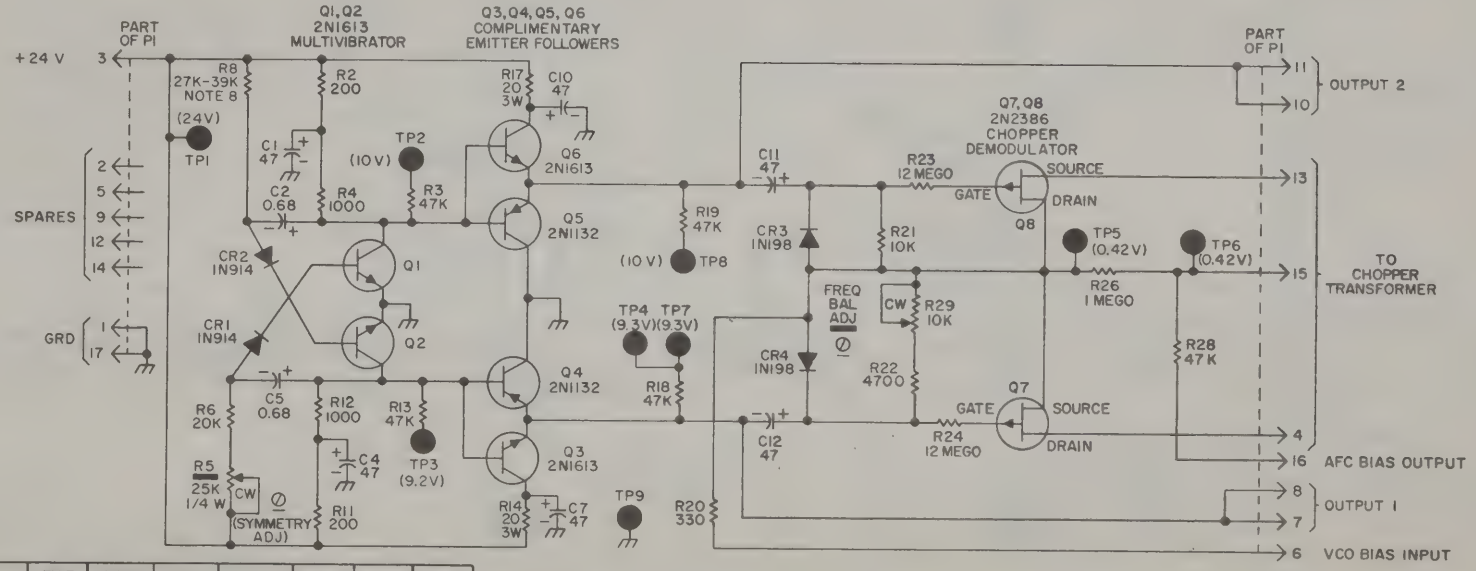


TYPICAL WAVESHAPE AT TP5 & 6



NOTES:

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. PREFIX THE DESIGNATION WITH UNIT NUMBER OR ASSEMBLY DESIGNATION OR BOTH.
2. UNLESS OTHERWISE INDICATED ALL RESISTANCE VALUES ARE IN OHMS, 1/2 WATT, ALL CAPACITANCE VALUES ARE IN UF
3. Q3, Q4, Q5, AND Q6 REQUIRE HEAT SINKS.
4. ITEMS IN PARENTHESIS ARE FOR REFERENCE ONLY AND ARE NOT NECESSARILY STENCILED.
5. ALL VOLTAGE AND RESISTANCE MEASUREMENTS ARE NOMINAL AND ARE TAKEN BETWEEN SPECIFIED PIN AND GROUND WITH RCA VTVM TYPE WV98C OR EQUIVALENT.
6. ALL RESISTANCE MEASUREMENTS ARE TAKEN WITH ALL EXTERNAL CONNECTIONS REMOVED.
7. WAVESHAPES TAKEN IN THE CHASSIS WITH: HP130C SCOPE, R5 SET FOR A SYMMETRIC SQUARE WAVE APPROX 30MS AT TP4 AND R29 SET FOR EQUAL AMPLITUDE SAWTOOTH WAVEFORM AT TP5.
8. EXACT VALUE OF R8 TO BE DETERMINED IN TEST.



		EMIT	BASE	COLL
Q1	V	GRD	0.55	10
	R		6.3K	13.5K
Q2	V	GRD	0.53	10
	R		6.3K	13.5K
Q3	V	9.3	9.2	23
	R	28K	13.5K	11.5K
Q4	V	9.3	9.2	GRD
	R	28K	13.5K	
Q5	V	10	10	GRD
	R	28K	13.5K	

		EMIT	BASE	COLL
Q6	V	10	10	23
	R	28K	13.5K	11.5K
		SOURCE	GATE	DRAIN
Q7	V	0.42	8	0.42
	R	∞	∞	∞
Q8	V	0.42	8	0.42
	R	∞	∞	∞

MEASURED ON RX 1000 RANGE

23150-02

FIGURE 5—19. CHOPPER DEMODULATOR, SCHEMATIC DIAGRAM.

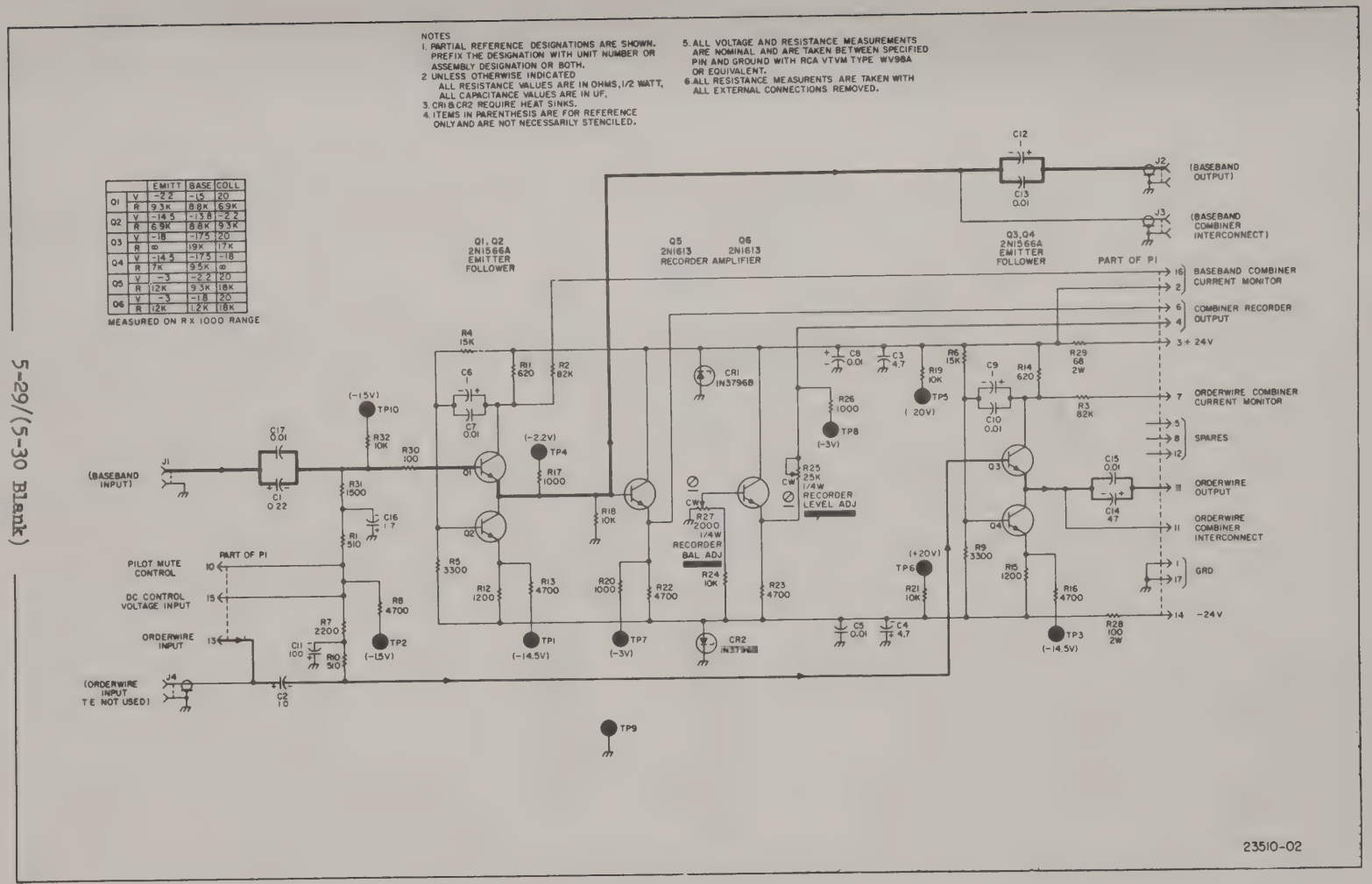
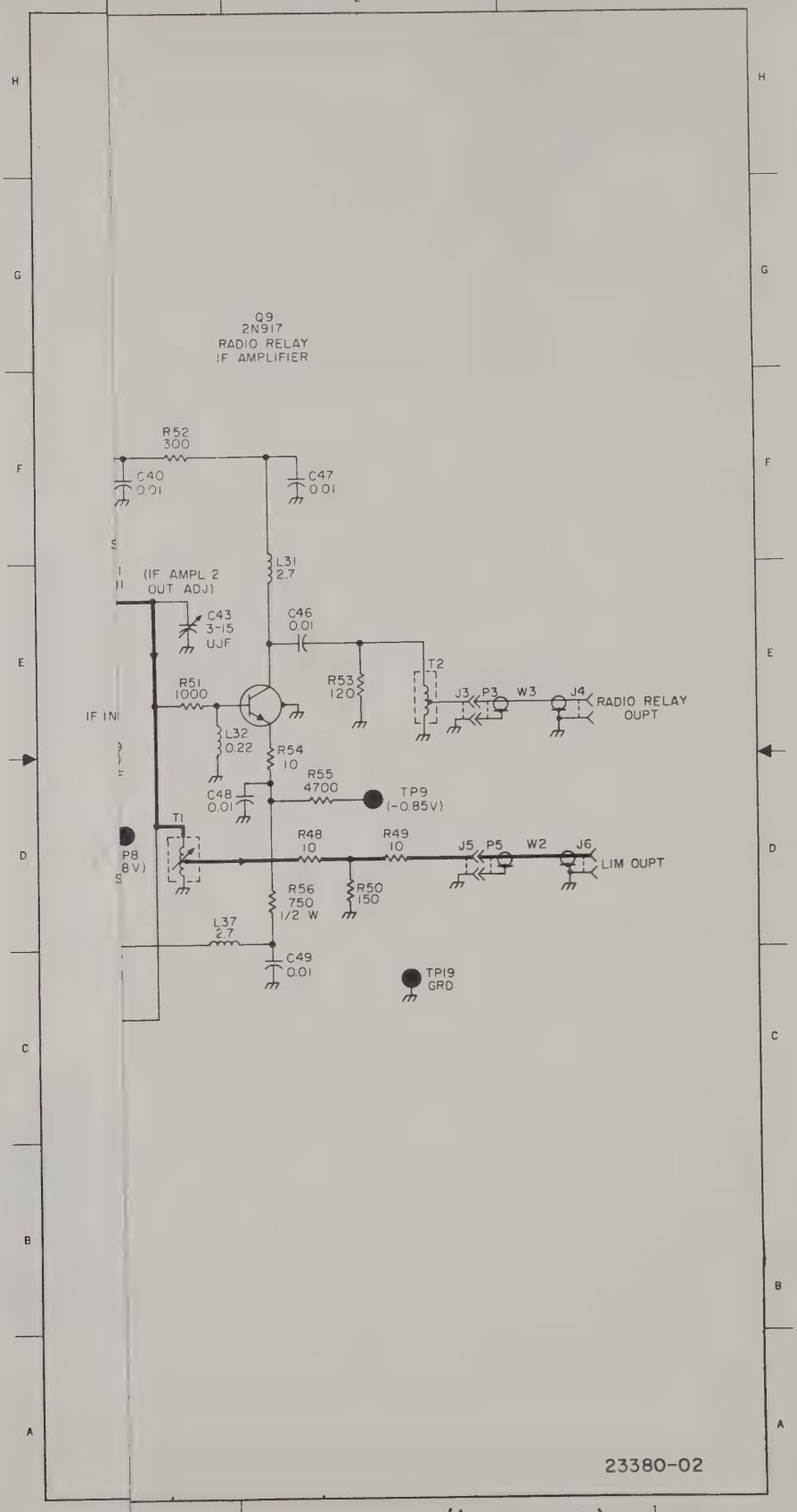


FIGURE 5—20. COMBINER, SCHEMATIC DIAGRAM.


Q9
2N917
RADIO RELAY
IF AMPLIFIER
R52
300
C40
0.01
C47
0.01
L31
2.7
(IF AMPL 2
OUT ADJ)
C43
3-15
UUF
C46
0.01
T2
R51
1000
R53
120
J3
P3
W3
J4
RADIO RELAY
OUPT
IF IN
L32
0.22
R54
10
R55
4700
TP9
(-0.85V)
C48
0.01
T1
P8
8V)
R48
10
R49
10
J5
P5
W2
J6
LIM OUPT
R56
750
1/2 W
R50
150
L37
2.7
C49
0.01
TP19
GRD
23380-02

NOTES
1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. PREFIX THE DESIGNATION WITH UNIT NUMBER OR ASSEMBLY DESIGNATION OR BOTH.
2. UNLESS OTHERWISE INDICATED ALL RESISTANCE VALUES ARE IN OHMS, 1/4 WATT, ALL CAPACITANCE VALUES ARE IN UF, ALL INDUCTANCE VALUES ARE IN UH
3. Q8 REQUIRES HEAT SINK
4. ITEMS IN PARENTHESIS ARE FOR REFERENCE ONLY AND ARE NOT NECESSARILY STENCILED.
5. ALL VOLTAGE AND RESISTANCE MEASUREMENTS ARE NOMINAL AND ARE TAKEN BETWEEN SPECIFIED PIN AND GROUND WITH RCA VTVM TYPE WV98A OR EQUIVALENT
6. ALL RESISTANCE MEASUREMENTS ARE TAKEN WITH ALL EXTERNAL CONNECTIONS REMOVED.

Q1 2N917 COMPRESSOR IF AMPLIFIER(1)
Q2 2N917 COMPRESSOR IF AMPLIFIER(2)
Q3 2N917 COMPRESSOR IF AMPLIFIER(3)
Q4 2N917 CLIPPER IF AMPLIFIER(1)
Q5 2N917 CLIPPER IF AMPLIFIER(2)
Q6 2N917 CLIPPER IF AMPLIFIER(3)
Q7 2N917 IF AMPLIFIER(1)
Q8 2N2951 IF AMPLIFIER(2)
Q9 2N917 RADIO RELAY IF AMPLIFIER

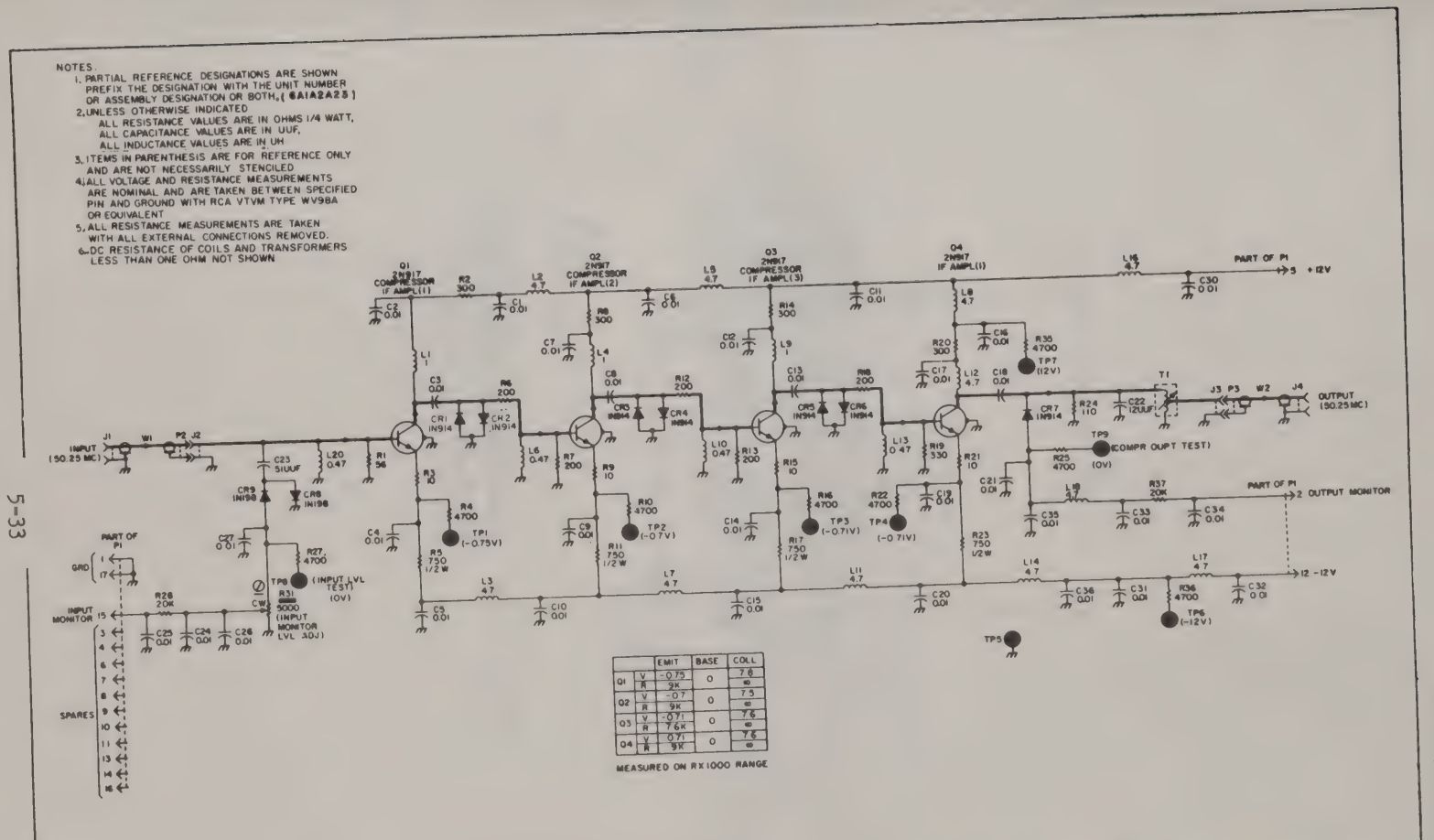
PART OF P1
+12V 5
GRD 1 17
SPARES 2 3 4 7 8 9 10
SPARES 11 13 14 15 16
-12V 12
LIMITER OUTPUT 6 MONITOR
IF INPUT
J1 W1 P2 J2
L36 2.7
C65 0.01
L4 2.7
L8 2.7
L14 2.7
L15 2.7
L21 2.7
L25 2.7
L30 2.7
R52 300
C40 0.01
C47 0.01
TP15 COMPR TEST (0V)
R23 4700
C20 0.01
CR7 IN914
C1 0.01
R2 300
C2 0.01
L2 0.47
C3 0.01
CR1 IN914
CR2 IN914
R8 180
L1 0.82
R1 51
R3 39
R4 4700
TP1 (-1.3V)
C4 0.01
R5 750 1/2 W
R70 4700
TP13 (-12V)
L35 2.7
C63 0.01
C62 0.01
C5 0.01
L3 2.7
R11 300
C9 0.01
L7 0.33
C8 0.01
CR3 IN914
CR4 IN914
R13 180
R9 150
L5 0.22
R10 10
R7 4700
TP2 (-0.85V)
C7 0.01
R6 750 1/2 W
C6 0.01
L6 2.7
C10 0.01
C11 0.01
R12 300
C12 0.01
L9 0.33
C13 0.01
CR5 IN914
CR6 IN914
R20 180
R14 150
L10 0.22
R15 10
R17 4700
TP3 (-0.85V)
C14 0.01
R16 750 1/2 W
C15 0.01
L11 2.7
C17 0.01
R24 300
C19 0.01
L13 0.33
C18 0.01
CR8 IN914
CR9 IN914
R26 180
R21 150
L12 0.33
R22 10
R19 4700
TP4 (-0.85V)
C16 0.01
R18 750 1/2 W
L17 2.7
C21 0.01
C23 0.01
L20 0.47
C24 0.01
CR10 IN914
CR11 IN914
R33 180
R27 150
L16 0.33
R28 10
R29 4700
TP5 (-0.85V)
C25 0.01
R30 750 1/2 W
C26 0.01
L18 2.7
R25 300
C22 0.01
L22 0.47
C29 0.01
CR12 IN914
CR13 IN914
R38 150
R34 150
L19 0.33
R35 10
R32 4700
TP6 (-0.85V)
C28 0.01
R31 750 1/2 W
C27 0.01
L23 2.7
R36 300
C31 0.01
L26 4.7
C34 0.01
L27 0.33
R39 150
L24 0.15
R40 10
R41 4700
TP7 (-0.85V)
C35 0.01
R42 750 1/2 W
C36 0.01
L28 2.7
R37 300
C32 0.01
C42 1.5 UUF
C66 2-8 UUF
(IF AMPL 1 OUT ADJ)
R71 4700
TP14 (12V)
C30 0.01
L29 4.7
C41 0.01
(IF AMPL 2 OUT ADJ)
C43 3-15 UUF
R46 150
C39 150 UUF
R45 27
R44 4700
TP8 (-1.8V)
C38 0.01
R43 220 1W
C37 0.01
L31 2.7
C46 0.01
R51 1000
L32 0.22
R54 10
R55 4700
TP9 (-0.85V)
C48 0.01
R48 10
R49 10
R56 750 1/2 W
R50 150
L37 2.7
C49 0.01
T1
T2
R53 120
J3 P3 W3 J4 RADIO RELAY OUPT
J5 P5 W2 J6 LIM OUPT
TP19 GRD
R58 IMEG
R57 IMEG
R47 47K
CR14 IN914
C50 1000 UUF
C45 1000 UUF
C44 0.01
TP16 LIM TEST (-0.5V)

		EMIT	BASE	COLL
Q1	V	-1	0	7.2
	R	∞	0.2(a)	∞
Q2	V	-0.7	0	7.2
	R	∞	0.2(a)	∞
Q3	V	-0.7	0	7.3
	R	∞	0.2(a)	∞
Q4	V	-0.7	0	7.6
	R	∞	0.2(a)	∞
Q5	V	-0.7	0	7.2
	R	∞	0.2(a)	∞
Q6	V	-0.7	0	7.3
	R	∞	0.2(a)	∞
Q7	V	-0.7	0	7.4
	R	∞	0.2(a)	∞
Q8	V	-1.3	-0.05	11.8
	R	∞	160(b)	∞
Q9	V	-0.7	0	7
	R	∞	0.2(a)	∞

a- MEASURED ON Rx1 RANGE
b- MEASURED ON Rx100 RANGE

23380-02

FIGURE 5-21. COMPRESSOR-LIMITER, SCHEMATIC DIAGRAM.



		EMIT	BASE	COLL
Q1	V	-0.75	0	7.8
	R	9K		∞
Q2	V	-0.7	0	7.5
	R	9K		∞
Q3	V	-0.71	0	7.6
	R	7.6K		∞
Q4	V	0.71	0	7.6
	R	9K		∞

FIGURE 5–22. COMPRESSOR–LIMITERS, (AFC) TYPE 1130, SCHEMATIC DIAGRAM.

23460-02

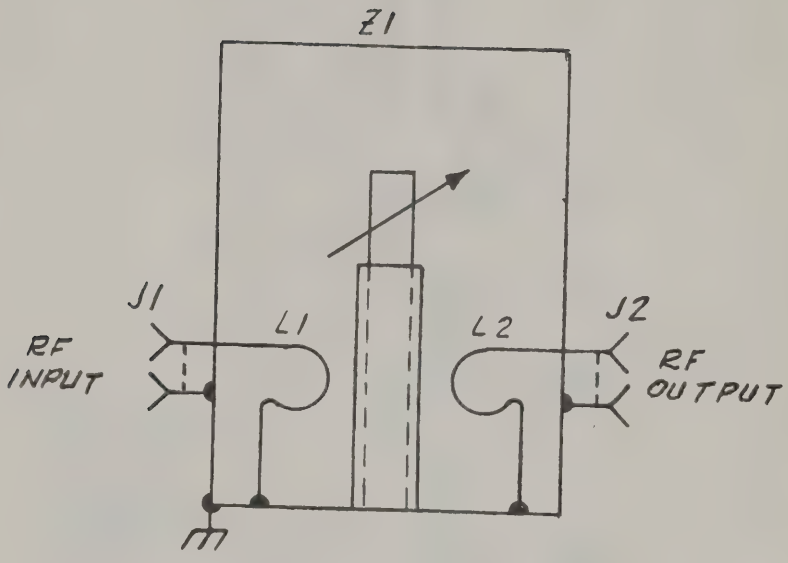


FIGURE 5—23. CONVERTER PRESELECTOR, SCHEMATIC DIAGRAM.

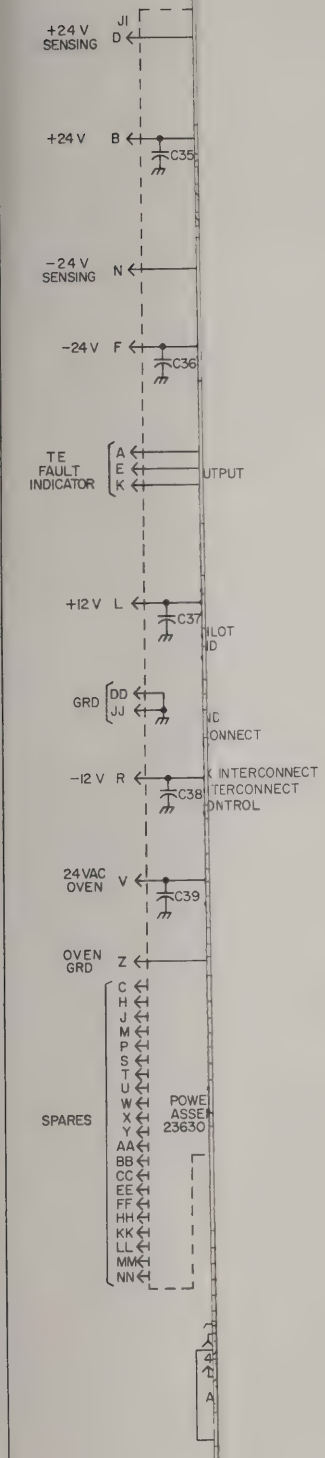


TABLE "A"

RCVR/ CHAN CAP		A3 IF FILTER	A5 DRIVER DISCR	A7 PHASE EQ	A10 BW SEL	A13 BB AMPL	A14 SHAPING FILTER	A27 CHAN CAP SEL	A33 ALARM AMPL	A34 NA REF & REC AMPL	A35 MON CONT SECT	A37 METER & SW ASSY	A41 HP FILTER	A43 PILOT FILTER	A44 PILOT XTAL FILTER
TYPE 1119 RCVR	12 CH	PF-1633	23390	PF-1713	24732	23551	PF-1709	24727	23581/6(a) 23582/8(b)	23591(a) 23590(b)	23601	23611	PF-1564	PF-1529(a) PF-1455(b)	FL-5255(a) FL-5246(b)
	24 CH	PF-1533		PF-1534	24730		PF-1532	23496					PF-1589		
	36 CH	PF-1631		PF-1714	24731		PF-1710	24720					PF-1712		
	60/72 CH	PF-1425		PF-1442	24080		PF-1448	23495(e)					PF-1432		
	132 CH	PF-1394	23391	PF-1443	24081		PF-1449	23494					PF-1433		
TYPE 1125 RCVR	24 CH	PF-1533	23390	PF-1534	24730	23550	PF-1532	24720	23583	23590	23600	23612	PF-1589	PF-1536	FL-5256
TYPE 1130 RCVR	60/72 CH	PF-1425	23390	PF-1442	24080	23551	PF-1448	(c)	23581/6(a) 23582/8(b)	23591(a) 23590(b)	23601	23611	PF-1432	PF-1529(a) PF-1455(b)	FL-5255(a) FL-5246(b)
	132 CH	PF-1394	23391	PF-1443	24081		PF-1449	23494					PF-1433		
TYPE 1161 RCVR	60/72 CH	PF-1425	23390(d)	PF-1442	24080	23551	PF-1448	24726	23581/6(a)	23591(a)	23601	23611 NOTE 3	PF-1432	PF-1529(a)	FL-5255(a)
	120 CH	PF-1394	23391	PF-1443	24081		PF-1449	23498					PF-1433		

(a) = 8 KHz RADIO PILOT
(b) = 60 KHz RADIO PILOT
(c) = 23495 OR 24726
(d) = 23392 USED FOR 1161-200
(e) 30090 USED FOR PROJ 750

NOTES:
1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. PREFIX THE DESIGNATION WITH UNIT NUMBER OR ASSEMBLY DESIGNATION OR BOTH.
2. UNLESS OTHERWISE INDICATED:
   ALL RESISTANCE VALUES ARE IN OHMS, 1/4 W,
   ALL CAPACITANCE VALUES ARE 1000 UUF,
   ALL INDUCTANCE VALUES ARE 3.3 UH.
3. ON PROJECT 733 SHAPE RELOCATION, METER & SWITCH ASSEMBLY 23618 AND FRONT PANEL ASSEMBLY 23644 ARE SUPPLIED.

22771-02

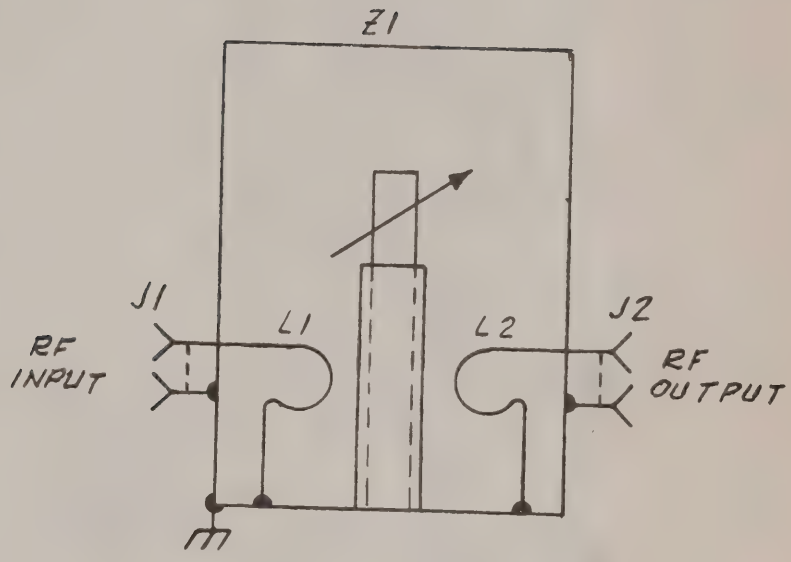


FIGURE 5—23. CONVERTER PRESELECTOR, SCHEMATIC DIAGRAM.

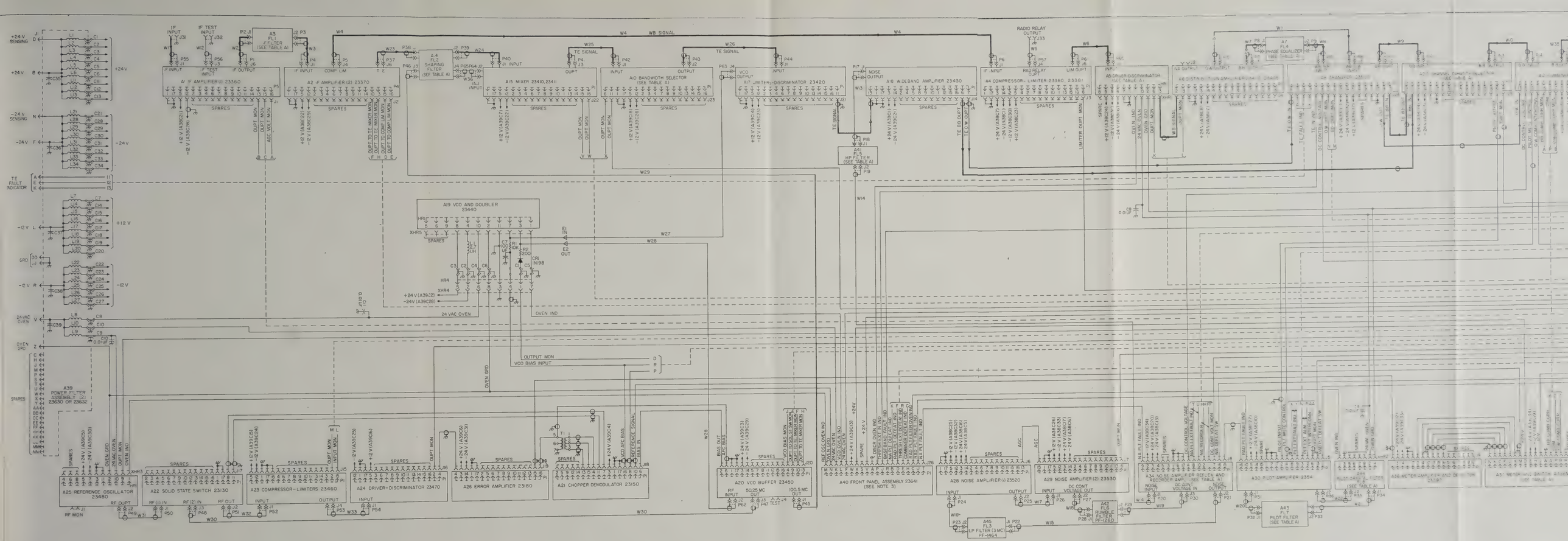


FIGURE 5-24. DEMODULATOR, TYPE 1130, SCHEMATIC DIAGRAM,

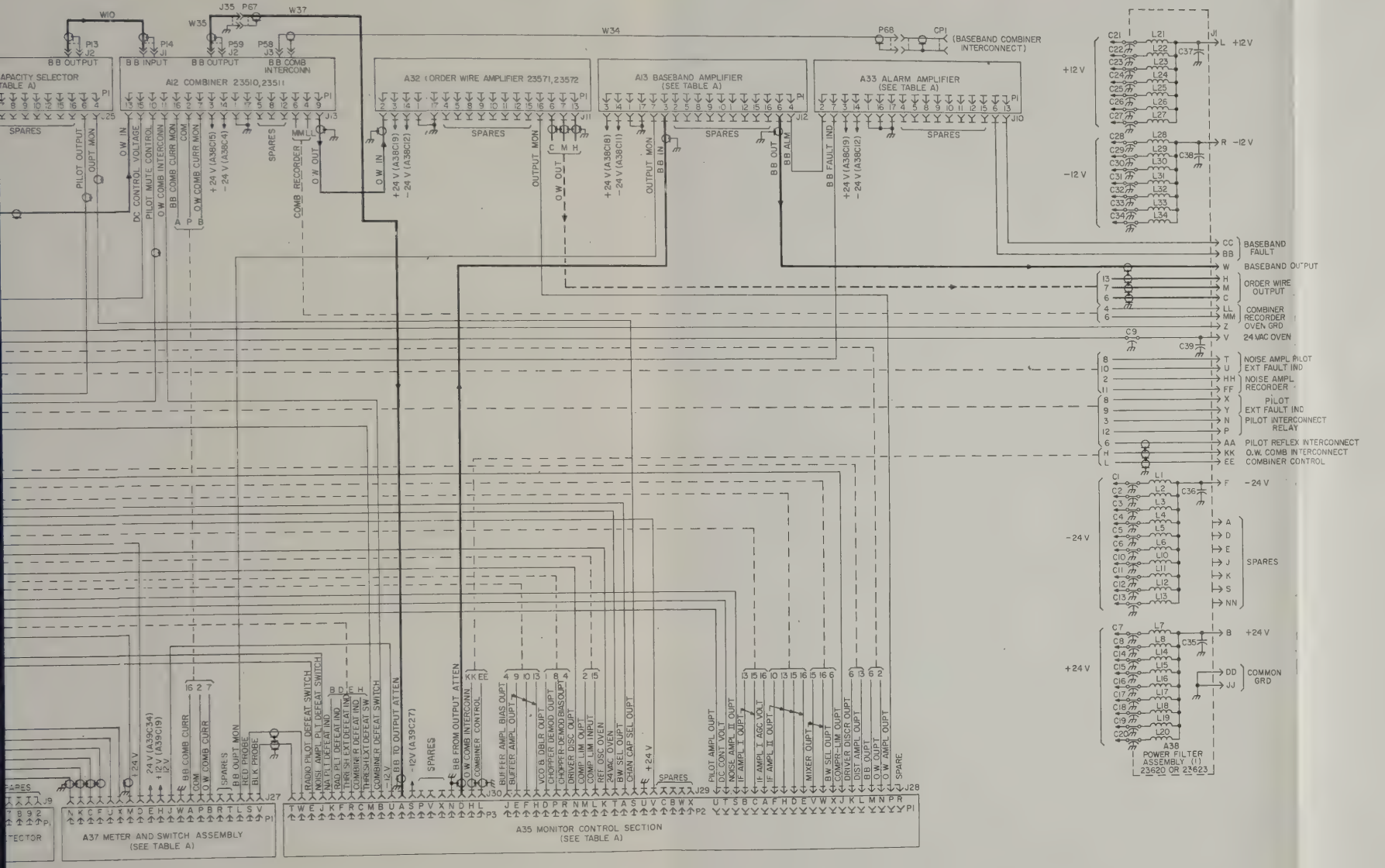


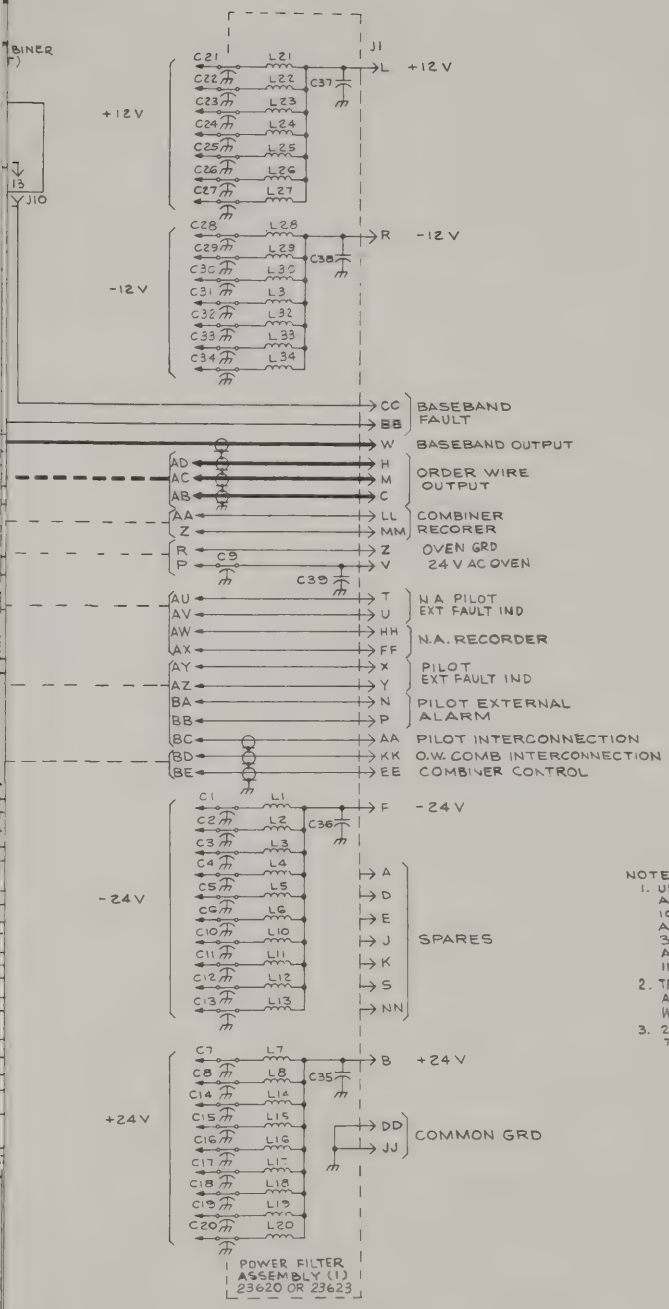
TABLE "A"

RCVR/ CHAN CAP		A3 IF FILTER	A5 DRIVER DISCR	A7 PHASE EQ	A10 BW SEL	A13 BB AMPL	A14 SHAP.NG FILTER	A27 CHAN CAP SEL	A33 ALARM AMPL	A34 NA REF & REC AMPL	A35 MON CONT SECT	A37 METER & SW ASSY	A41 HP FILTER	A43 P.LOT FILTER	A44 PILOT XTAL FILTER
TYPE 1119 RCVR	12 CH	PF-1633	23390	PF-1713	24732	23551	PF-1709	24727	23581/6(a) 23582/8(b)	23591(a) 23590(b)	23601	23611	PF-1564	PF-1529(a) PF-1455(b)	FL-5255(a) FL-5246(b)
	24 CH	PF-1533		PF-1534	24730		PF-1532	23496					PF-1589		
	36 CH	PF-1631		PF-1714	24731		PF-1710	24720					PF-1712		
	60/72 CH	PF-1425		PF-1442	24080		PF-1448	23495(c)					PF-1432		
	132 CH	PF-1394	23391	PF-1443	24081		PF-1449	23494					PF-1433		
TYPE 1125 RCVR	24 CH	PF-1533	23390	PF-1524	24730	23550	PF-1532	24720	23583	23590	23600	23612	PF-1589	PF-1536	FL-5256
TYPE 1130 RCVR	60/72 CH	PF-1425	23390	PF-1442	24080	23551	PF-1448	(c)	23581/6(a) 23582/8(b)	23591(a) 23590(b)	23601	23611	PF-1432	PF-1529(a) PF-1455(b)	FL-5255(a) FL-5246(b)
	132 CH	PF-1394	23391	PF-1443	24081		PF-1449	23494					PF-1433		
TYPE 1161 RCVR	60/72 CH	PF-1425	23390(d)	PF-1442	24080	23551	PF-1448	24726	23581/6(a)	23591(a)	23601	23611 NOTE 3	PF-1432	PF-1529(a)	FL-5255(a)
	120 CH	PF-1394	23391	PF-1443	24081		PF-1449	23498					PF-1433		

(a) = 8 KHz RADIO PILOT
(b) = 60 KHz RADIO PILOT
(c) = 23495 OR 24726
(d) = 23392 USED FOR 1161-200
(e) 30090 USED FOR PROJ 750

NOTES
1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. PREFIX THE DESIGNATION WITH UNIT NUMBER OR ASSEMBLY DESIGNATION OR BOTH.
2. UNLESS OTHERWISE INDICATED:
   ALL RESISTANCE VALUES ARE IN OHMS, 1/4 W,
   ALL CAPACITANCE VALUES ARE 1000 UUF,
   ALL INDUCTANCE VALUES ARE 3.3 UH.
3. ON PROJECT 733 SHAPE RELOCATION, METER & SWITCH ASSEMBLY 23618 AND FRONT PANEL ASSEMBLY 23644 ARE SUPPLIED.

22771-02



NOTE:
1. UNLESS OTHERWISE INDICATED: ALL CAPACITANCE VALUES ARE 1000 UUF ALL INDUCTANCE VALUES ARE 3.3 UH ALL RESISTANCE VALUES ARE IN OHMS, 1/4W
2. TERMINATION E1 USED ONLY WHEN IF AMPLIFIER IS USED IN D-MODULATOR WITHOUT THRESHOLD EXTENSION.
3. 23392 DRIVER DISCR. IS USED FOR 72 CHAN CAP. ON 11617-200

22772-02

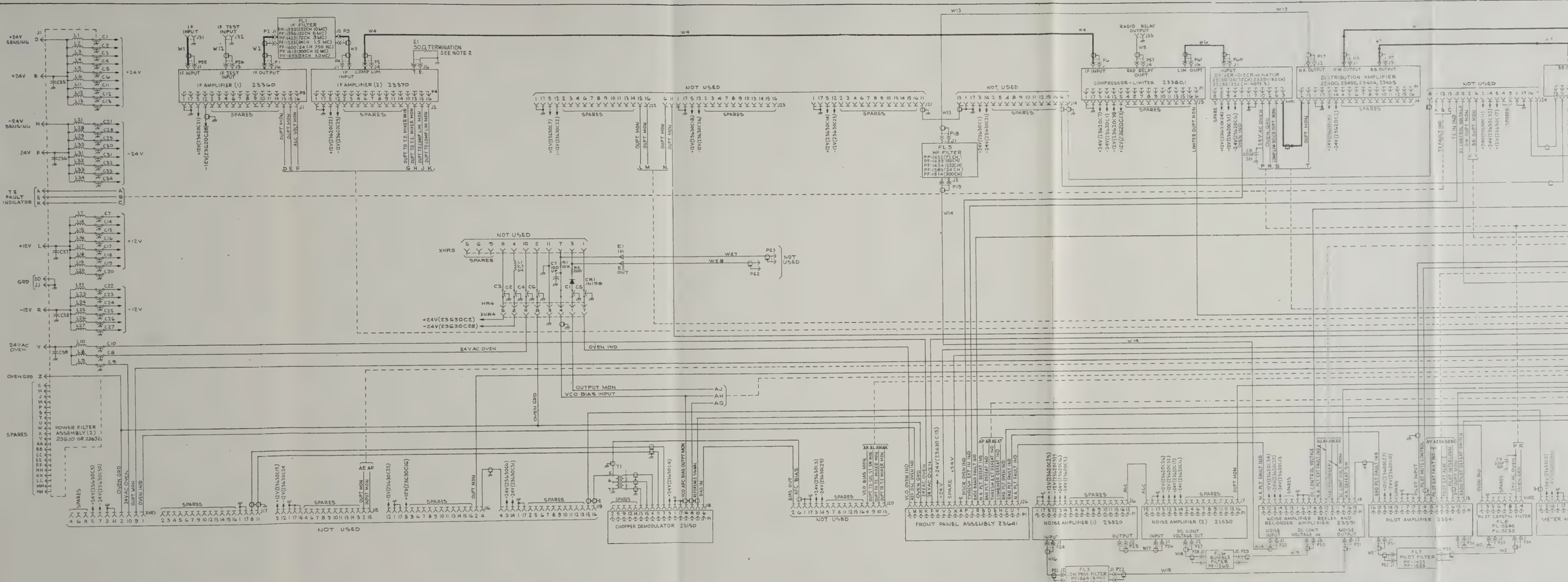


FIGURE 5–25. DEMODULATOR, TYPE 1130A, SCHEMATIC DIAGRAM.

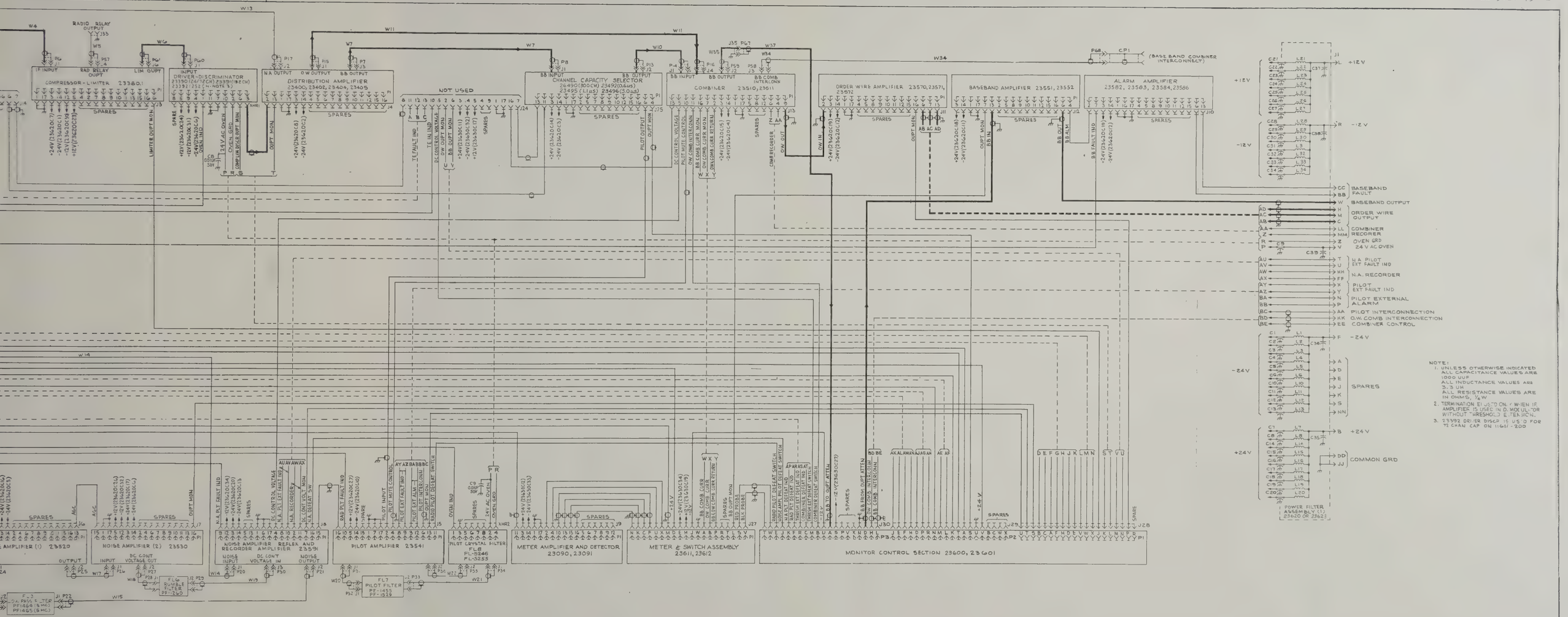
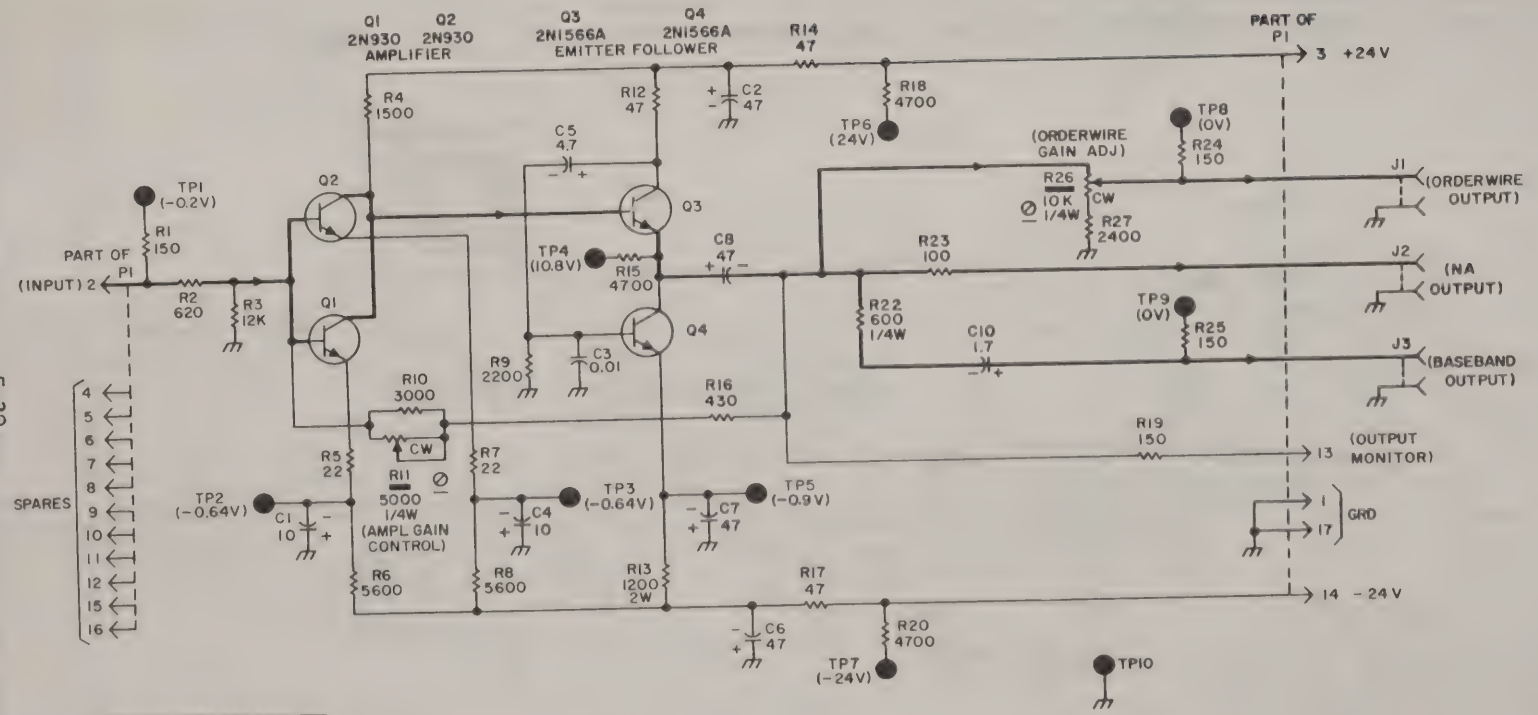


FIGURE 5-25. DEMODULATOR, TYPE 1130A, SCHEMATIC DIAGRAM.

22772-02

NOTES
1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. PREFIX THE DESIGNATION WITH UNIT NUMBER OR ASSEMBLY DESIGNATION OR BOTH.
2. UNLESS OTHERWISE INDICATED
   ALL RESISTANCE VALUES ARE IN OHMS, 1/2 WATT.
   ALL CAPACITANCE VALUES ARE IN UF.
3. Q3 AND Q4 REQUIRE HEAT SINKS.
4. ALL VOLTAGE AND RESISTANCE MEASUREMENTS TAKEN BETWEEN SPECIFIED PIN AND GROUND WITH VTVM. ALL RESISTANCE MEASUREMENTS TAKEN WITH ALL EXTERNAL CONNECTIONS REMOVED.
5. ITEMS IN PARENTHESIS ARE FOR REFERENCE ONLY, AND ARE NOT NECESSARILY STENCILED.



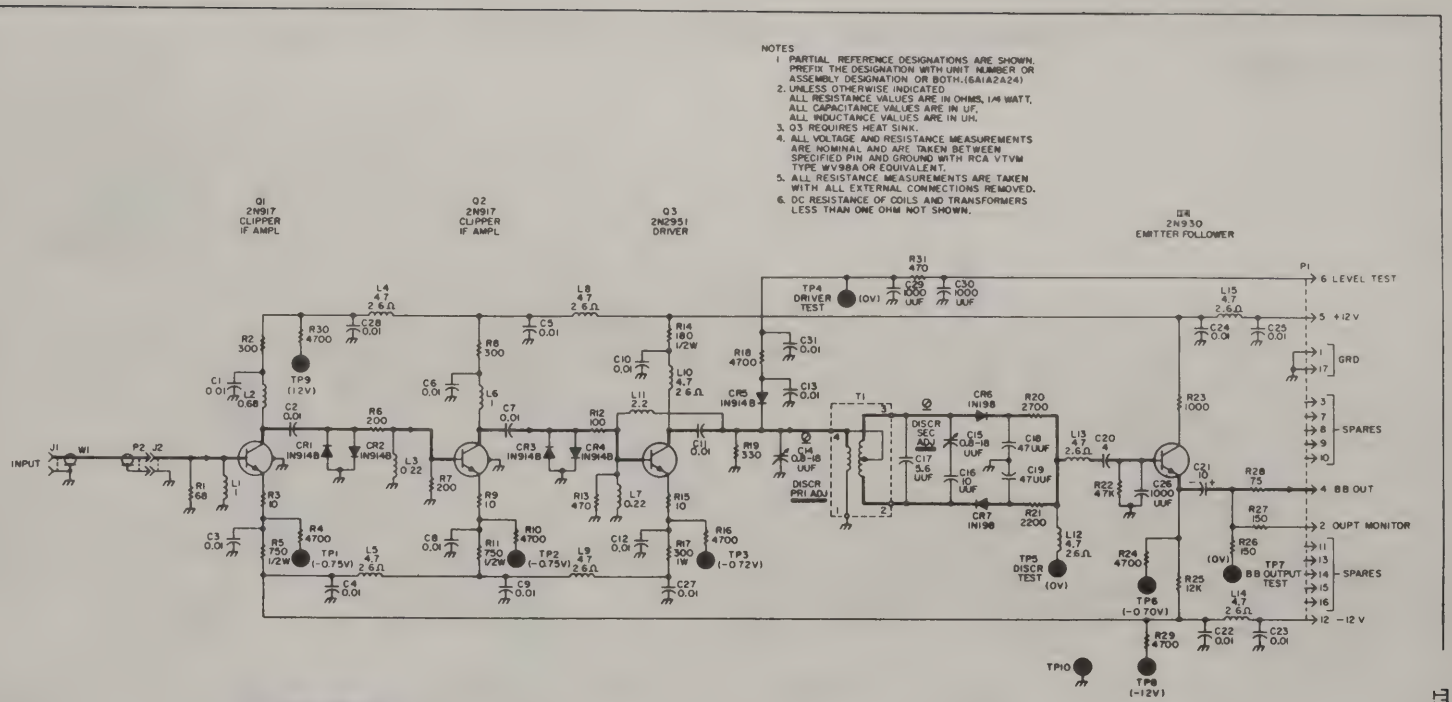
		EMIT	BASE	COLL
Q1	V	-0.64	-0.04	11.4
	R	∞	7.5K	∞
Q2	V	-0.64	-0.04	11.4
	R	∞	7.5K	∞
Q3	V	10.8	11.4	22
	R	∞	∞	∞
Q4	V	-0.9	-0.2	10.8
	R	∞	2.5K	∞

MEASURED ON RX1Q00 RANGE

23402-02

FIGURE 5—26. DISTRIBUTION AMPLIFIER, SCHEMATIC DIAGRAM.

TM 11-5820-794-14

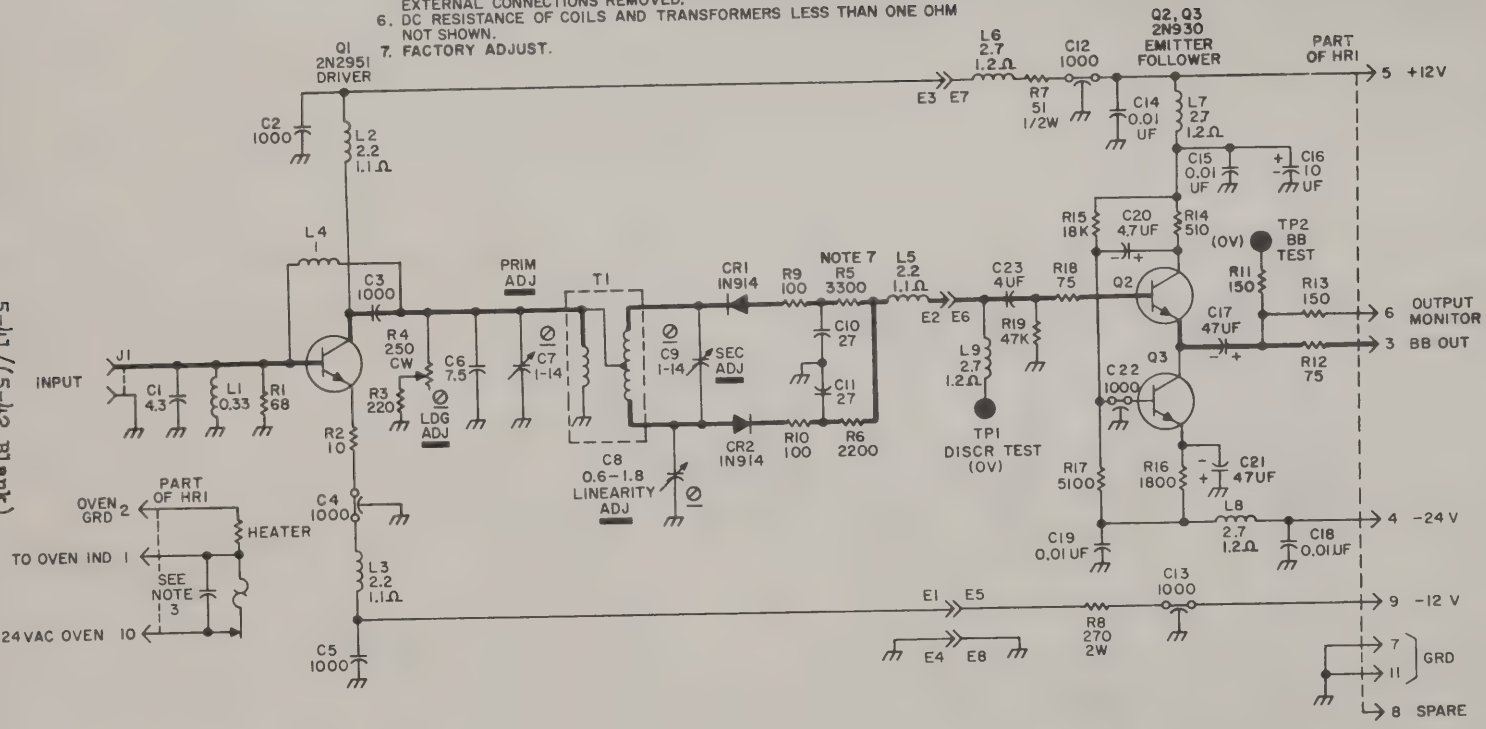


		EMIT	BASE	COLL
Q1	V	-0.75	0	7.5
	R	∞(b)	0.2(a)	∞(b)
Q2	V	-0.75	0	7.3
	R	∞(b)		∞(b)
Q3	V	-0.72	0	5.5
	R	∞(b)		∞(b)
Q4	V	-0.70	-0.1	11
	R	∞(b)	60K(b)	∞(b)

a- MEASURED ON RX1 RANGE
b- MEASURED ON RX1000 RANGE

FIGURE 5—27. DRIVER—DISCRIMINATOR (AFC) TYPE 1130, SCHEMATIC DIAGRAM. 23470-02

NOTES:
1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. PREFIX THE DESIGNATION WITH UNIT NUMBER OR ASSEMBLY DESIGNATION OR BOTH.
2. UNLESS OTHERWISE INDICATED:
   ALL RESISTANCE VALUES ARE IN OHMS, 1/4 WATT.
   ALL CAPACITANCE VALUES ARE IN UUF.
   ALL INDUCTANCE VALUES ARE IN UH.
3. 2000 UUF CAPACITOR IS PART OF OVEN.
4. ALL VOLTAGE AND RESISTANCE MEASURMENTS ARE NOMINAL AND ARE TAKEN BETWEEN SPECIFIED PIN AND GROUND WITH RCA VTVM TYPE WV98A OR EQUIVALENT.
5. ALL RESISTANCE MEASUREMENTS ARE TAKEN WITH ALL EXTERNAL CONNECTIONS REMOVED.
6. DC RESISTANCE OF COILS AND TRANSFORMERS LESS THAN ONE OHM NOT SHOWN.
7. FACTORY ADJUST.



		EMIT	BASE	COLL
Q1	V	-0.7	0	10
	R	∞(b)	0.1(a)	∞(b)
Q2	V	-0.7	0	9.6
	R	∞(b)	60K(b)	∞(b)
Q3	V	-16.8	-16.1	-0.7
	R	∞(b)	∞(b)	∞(b)

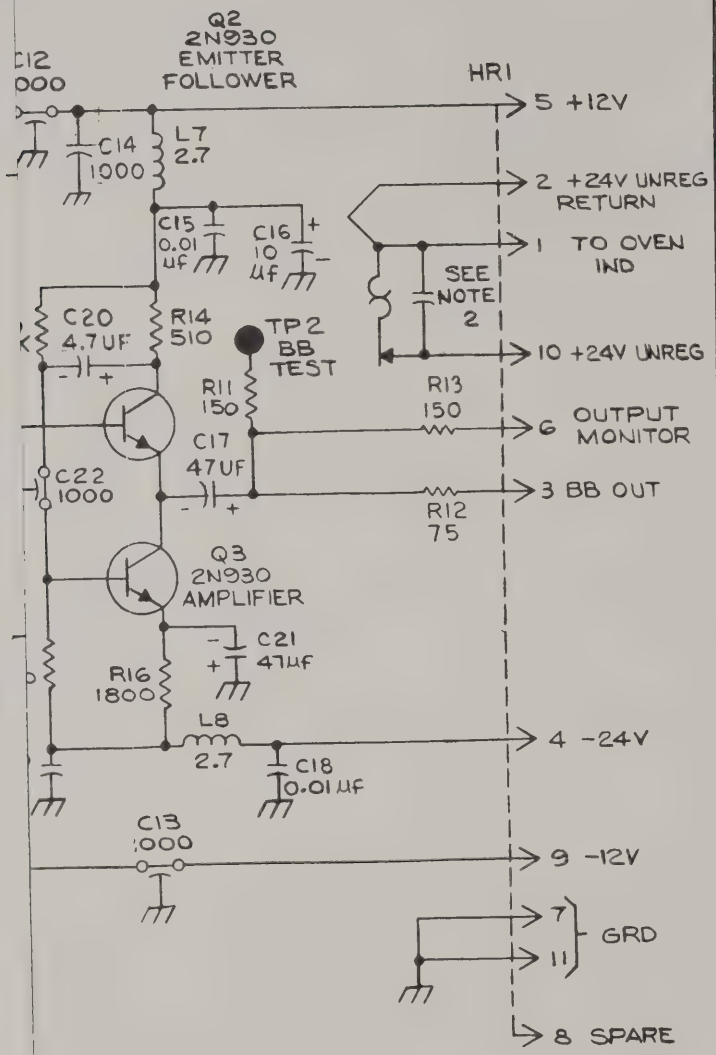
a- MEASURED ON RX1 RANGE.
b- MEASURED ON RX1000 RANGE.

23390-02

FIGURE 5-28. DRIVER-DISCRIMINATOR, (72 CHANNELS), SCHEMATIC DIAGRAM.

5-41/(5-42 Blank)

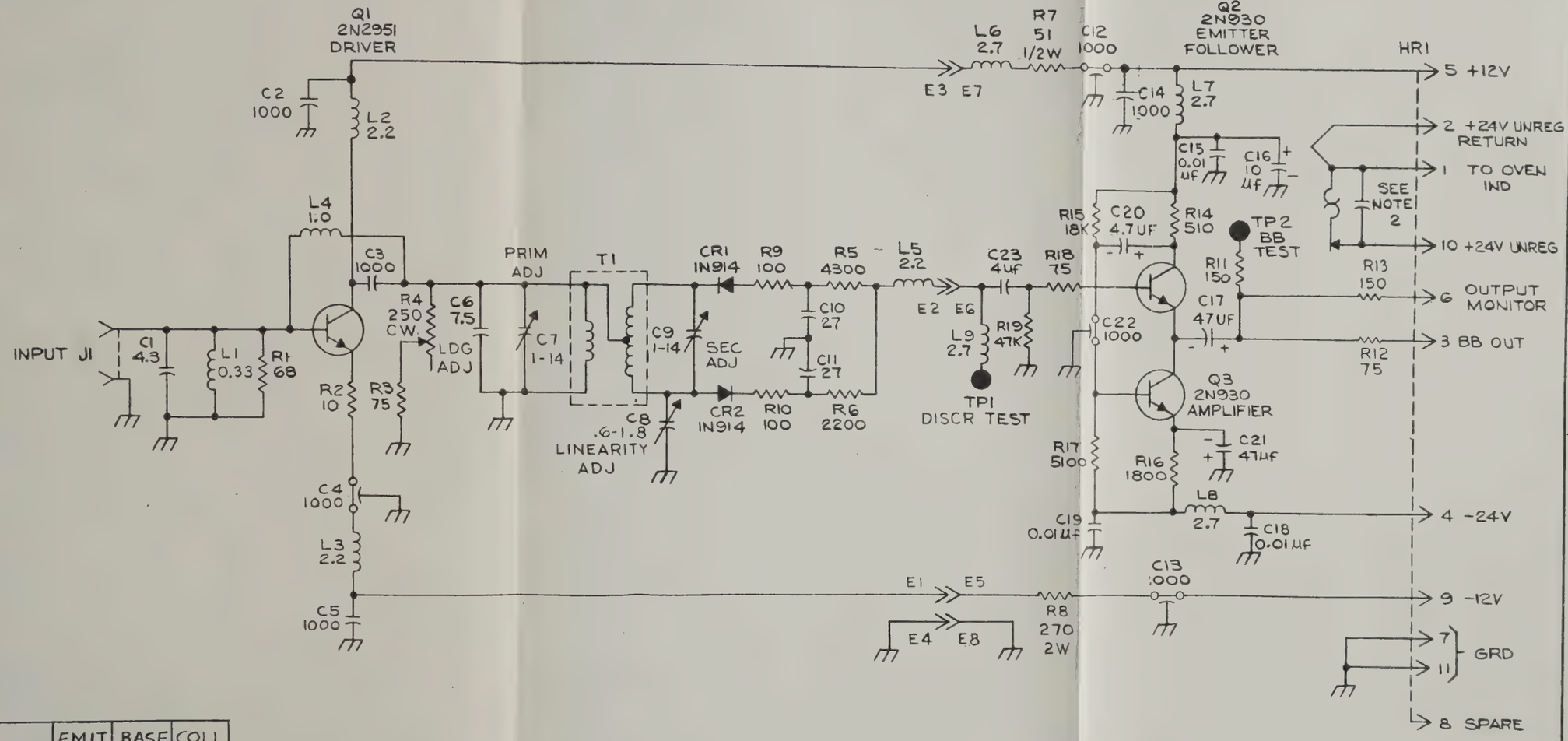
TM 11-5820-794-14



23391 -02

IC DIAGRAM.

NOTES:
1. UNLESS OTHERWISE INDICATED:
   ALL RESISTANCE VALUES ARE IN OHMS, 1/4 WATT
   ALL CAPACITANCE VALUES ARE IN UUF,
   ALL INDUCTANCE VALUES ARE IN UH.
2. 2000 UUF CAPACITOR IS PART OF OVEN.



		EMIT	BASE	COLL
Q1	V	-0.7	0	10
	R	∞	0.1(a)	∞
Q2	V	2.7	0	12.6
	R	∞	60Ω(b)	∞
Q3	V	2.6	3.3	2.7
	R	∞	∞	∞

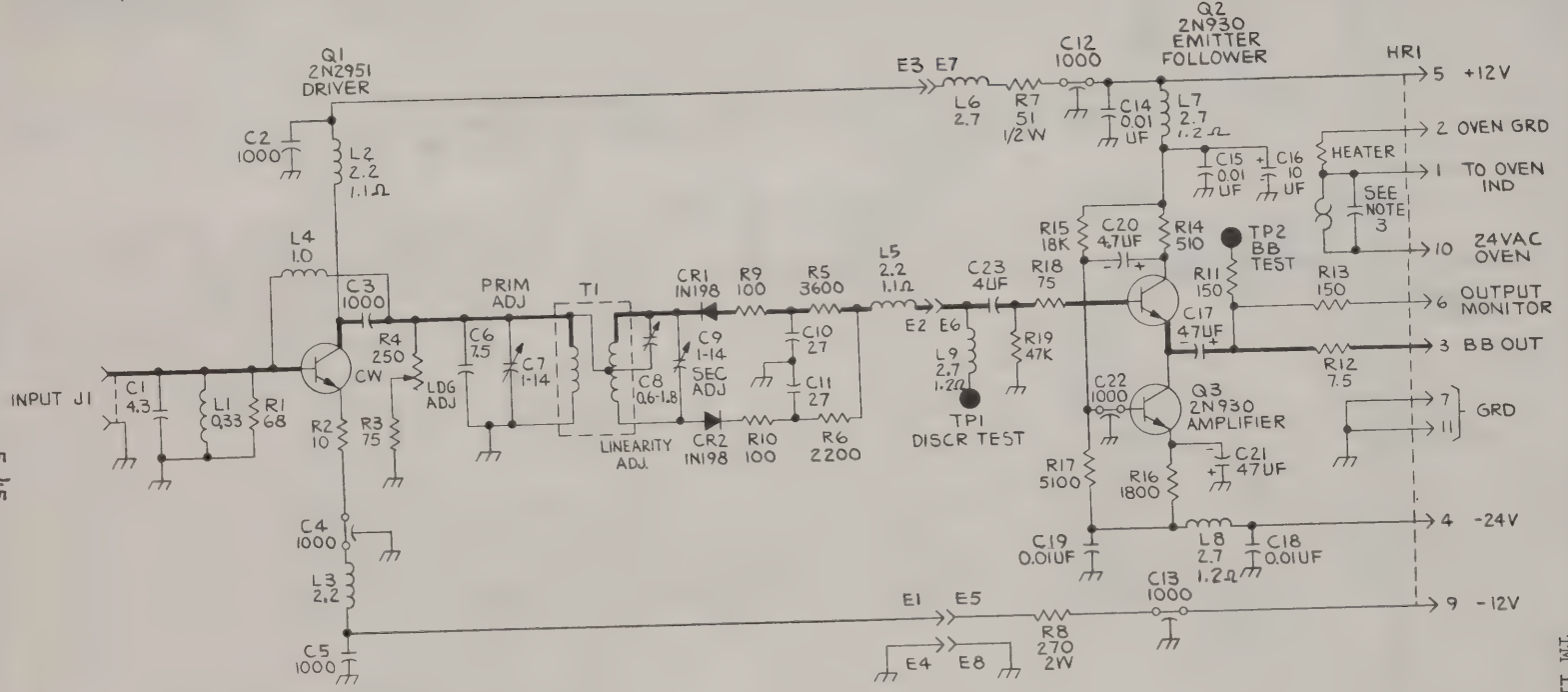
a- MEASURED ON RX1 SCALE
b- MEASURED ON RX1000 SCALE

23391-02

FIGURE 5—29. DRIVER—DISCRIMINATOR, (132 CHANNELS), SCHEMATIC DIAGRAM.

NOTES:

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. PREFIX THE DESIGNATION WITH UNIT NUMBER OR ASSEMBLY DESIGNATION OR BOTH.
2. UNLESS OTHERWISE INDICATED:
   ALL RESISTANCE VALUES ARE IN OHMS, 1/4 WATT,
   ALL CAPACITANCE VALUES ARE IN UUF,
   ALL INDUCTANCE VALUES ARE IN UH.
3. 2000 UUF CAPACITOR IS PART OF OVEN.
4. ALL VOLTAGE AND RESISTANCE MEASUREMENTS ARE TAKEN BETWEEN SPECIFIED PIN AND GROUND WITH RCA VTVM TYPE WV 98A OR EQUIVALENT.
5. ALL RESISTANCE MEASUREMENTS ARE TAKEN WITH ALL EXTERNAL CONNECTIONS REMOVED.
6. D.C. RESISTANCE OF COILS AND TRANSFORMERS LESS THAN ONE OHM NOT SHOWN.



		EMIT	BASE	COLL
Q1	V	-0.7	0	10
	R	∞	0.1(a)	∞
Q2	V	-0.7	0	9.6
	R	∞	60K(b)	∞
Q3	V	-16.8	-16.1	-0.7
	R	∞	∞	∞

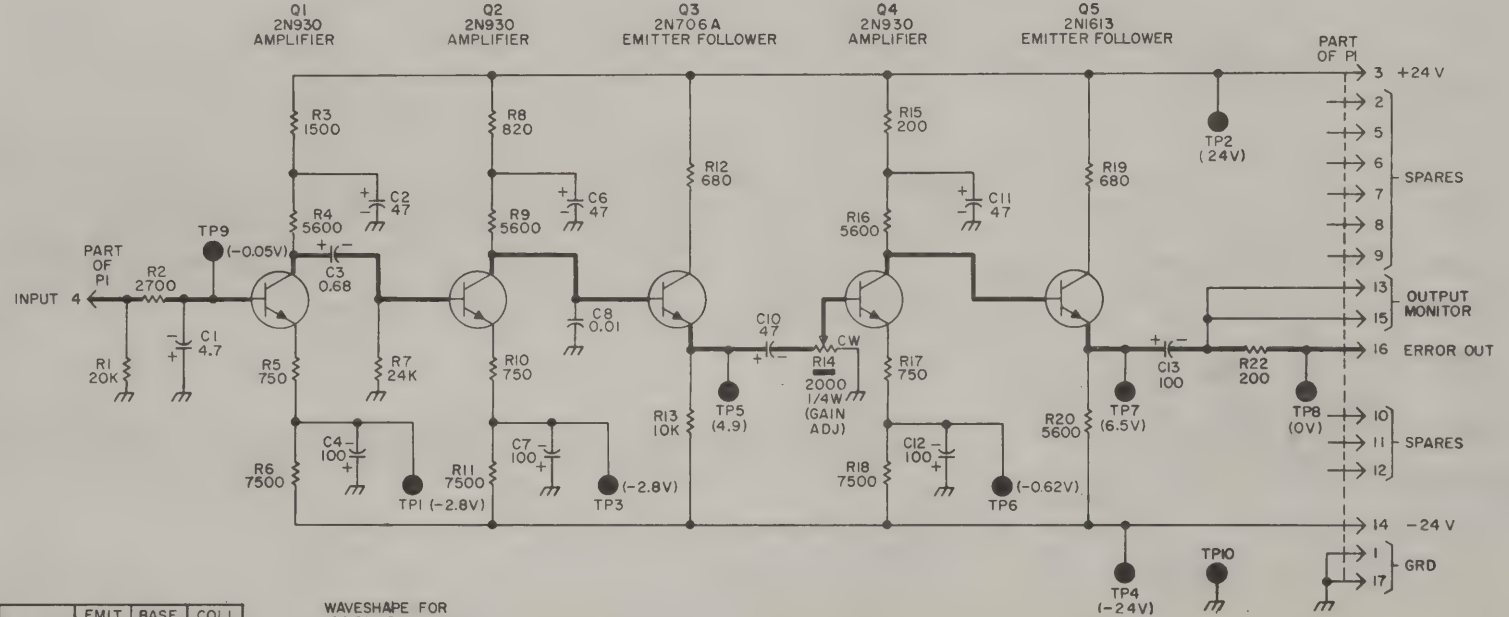
MEASURED ON
a- Rx1
b- Rx1000

FIGURE 5-30. DRIVER-DISCRIMINATOR, (252 CHANNELS), TYPE 1130A, SCHEMATIC DIAGRAM.

23392-02

NOTES:

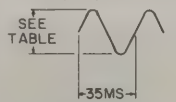
1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. PREFIX THE DESIGNATION WITH UNIT NUMBER OR ASSEMBLY DESIGNATION OR BOTH.
2. UNLESS OTHERWISE INDICATED ALL RESISTANCE VALUES ARE IN OHMS, 1/2 WATT, ALL CAPACITANCE VALUES ARE IN UF.
3. ITEMS IN PARENTHESIS ARE FOR REFERENCE ONLY AND ARE NOT NECESSARILY STENCILED.
4. ALL VOLTAGE AND RESISTANCE MEASUREMENTS ARE NOMINAL AND ARE TAKEN BETWEEN SPECIFIED PIN AND GROUND WITH RCA VTVM TYPE WV98A OR EQUIVALENT.
5. ALL RESISTANCE MEASUREMENTS ARE TAKEN WITH ALL EXTERNAL CONNECTIONS REMOVED.
6. WAVESHAPES TAKEN:
   a) WITH HP130C SCOPE & HP200CD OSC,
   b) WITH R14 MAX CCW,
   c) ARE BENCH MEASUREMENTS BUT CAN BE DUPLICATED IN THE CHASSIS BY OFFSETTING THE VCO BIAS ADJUSTMENT.



		EMIT	BASE	COLL
Q1	V	-0.68	-0.05	4.2
	R	0.5MEG	23K	∞
Q2	V	-0.82	-0.12	5.6
	R	0.5MEG	24K	∞
Q3	V	4.9	5.6	22
	R	0.5MEG	∞	∞
Q4	V	-0.62	-0.02	7.2
	R	0.5MEG	2K(a)	∞
Q5	V	6.5	7.2	20
	R	0.5MEG	∞	∞

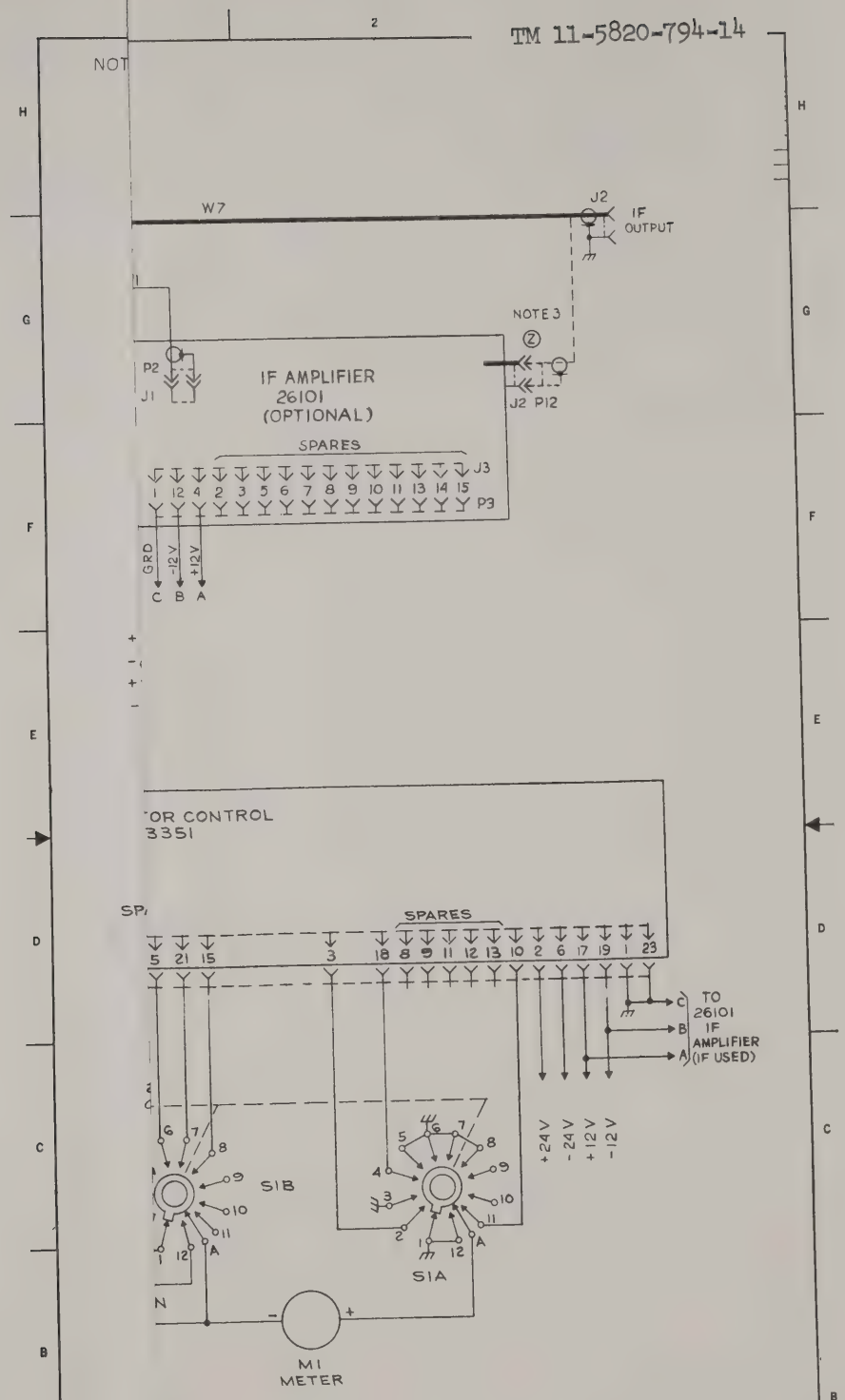
MEASURED ON R X 1000 RANGE
a- R14 FULLY CCW

WAVESHAPE FOR TP5, TP7, TP8 & TP9



TP5	90 MV
TP7 TP8	600 MV
TP9	2.5 MV

FIGURE 5-31. ERROR AMPLIFIER, SCHEMATIC DIAGRAM, TYPE 1130. 23180-02


NOT
W7
J2
IF OUTPUT
NOTE 3
IF AMPLIFIER 26101 (OPTIONAL)
P2
J1
J2 P12
SPARES
J3
P3
GRD
-12 V
+12V
C B A
OR CONTROL 3351
SPARES
TO 26101 IF AMPLIFIER (IF USED)
+24 V
-24 V
+12 V
-12 V
S1B
S1A
M1 METER

22761-02

NOTE:
PARTIAL REFERENCE DESIGNATIONS ARE SHOWN.
PREFIX THE DESIGNATION WITH UNIT NUMBER OR
ASSEMBLY DESIGNATION OR BOTH.

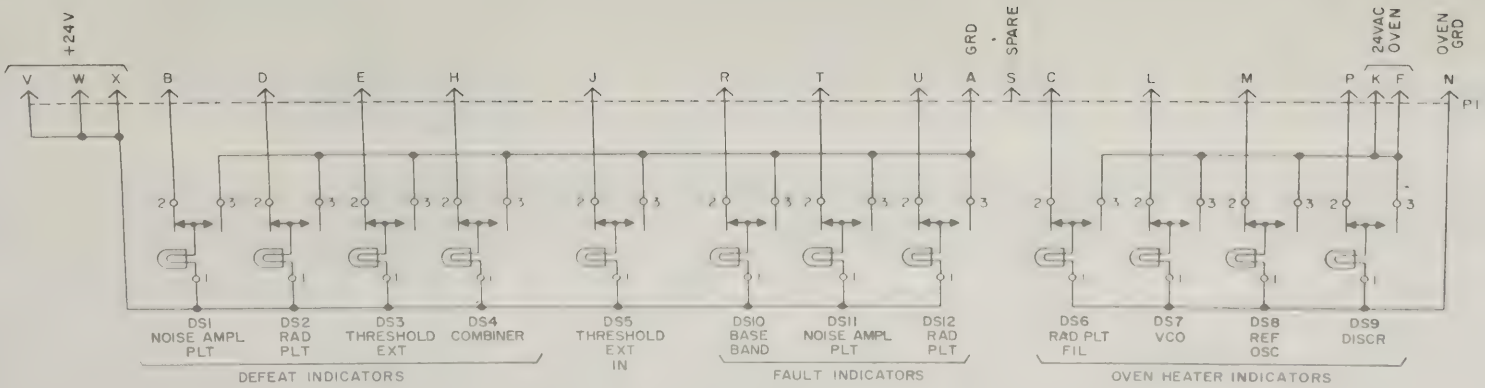
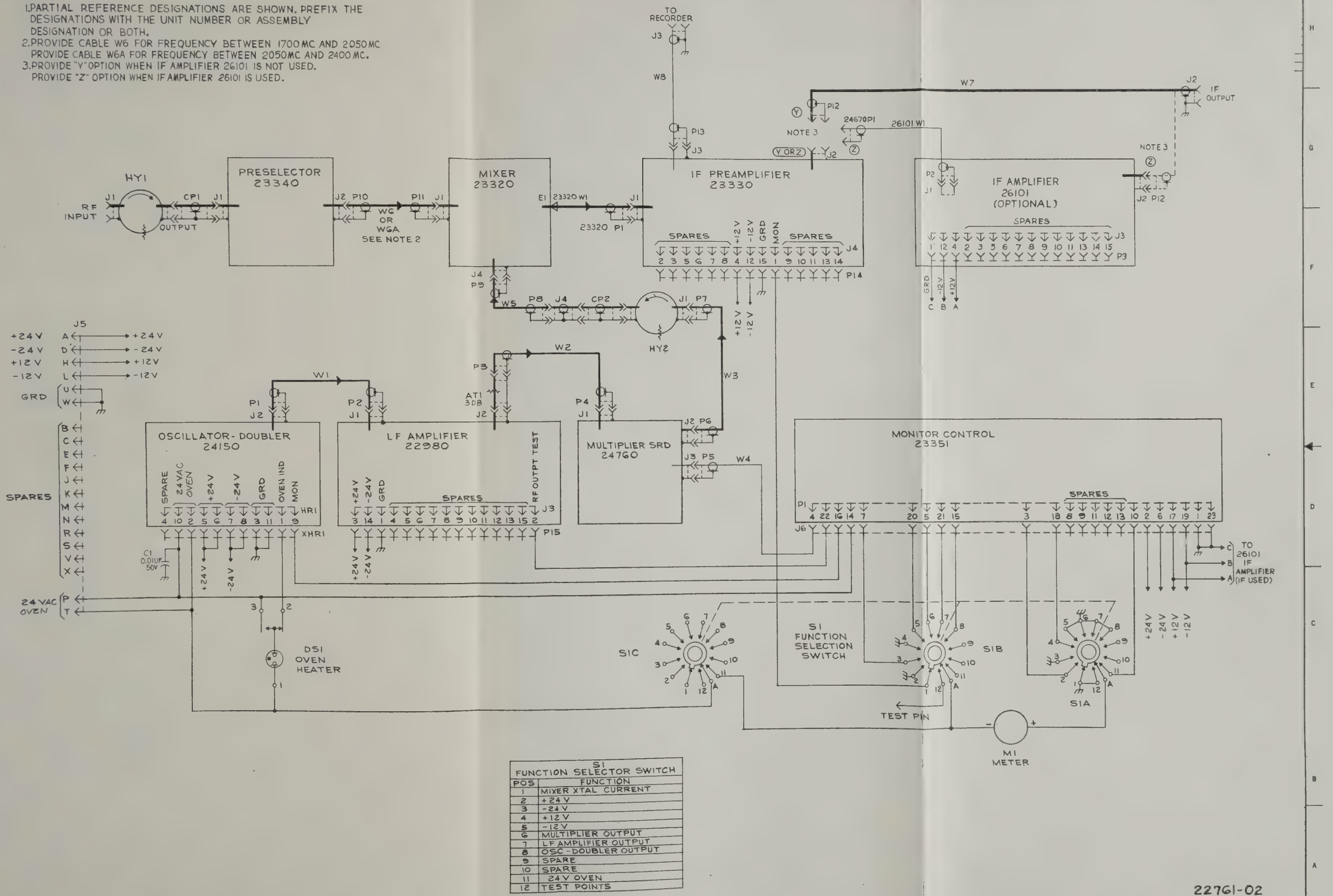


FIGURE 5-22. FRONT PANEL ASSEMBLY, SCHEMATIC DIAGRAM

23641-02

NOTES:
1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. PREFIX THE DESIGNATIONS WITH THE UNIT NUMBER OR ASSEMBLY DESIGNATION OR BOTH.
2. PROVIDE CABLE W6 FOR FREQUENCY BETWEEN 1700 MC AND 2050 MC. PROVIDE CABLE W6A FOR FREQUENCY BETWEEN 2050 MC AND 2400 MC.
3. PROVIDE "Y" OPTION WHEN IF AMPLIFIER 26101 IS NOT USED. PROVIDE "Z" OPTION WHEN IF AMPLIFIER 26101 IS USED.



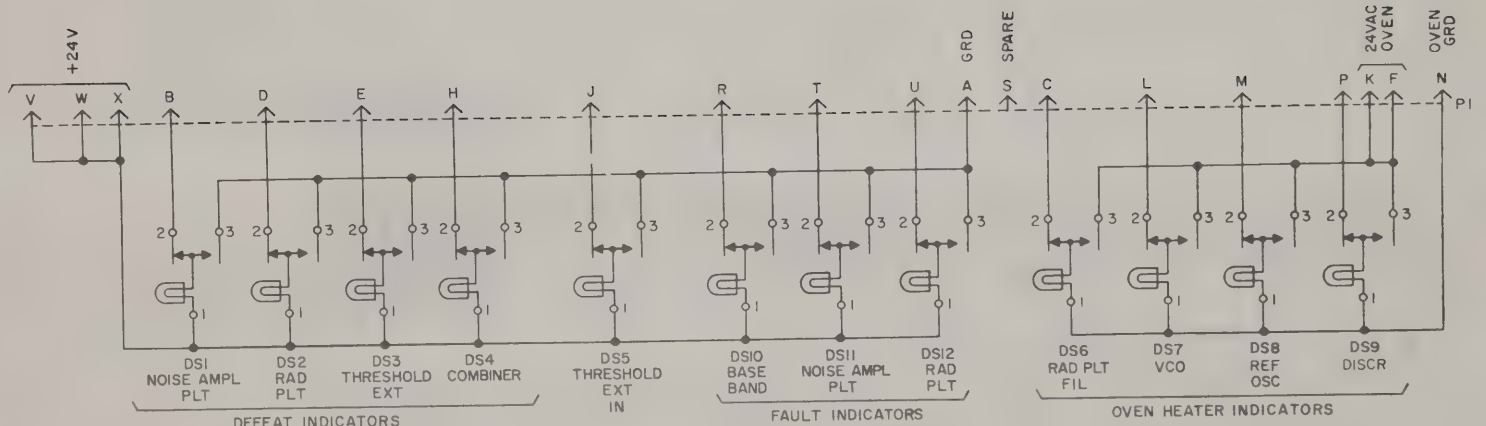
S1 FUNCTION SELECTOR SWITCH

POS	FUNCTION
1	MIXER XTAL CURRENT
2	+24 V
3	-24 V
4	+12 V
5	-12 V
6	MULTIPLIER OUTPUT
7	LF AMPLIFIER OUTPUT
8	OSC-DOUBLER OUTPUT
9	SPARE
10	SPARE
11	24 V OVEN
12	TEST POINTS

22761-02

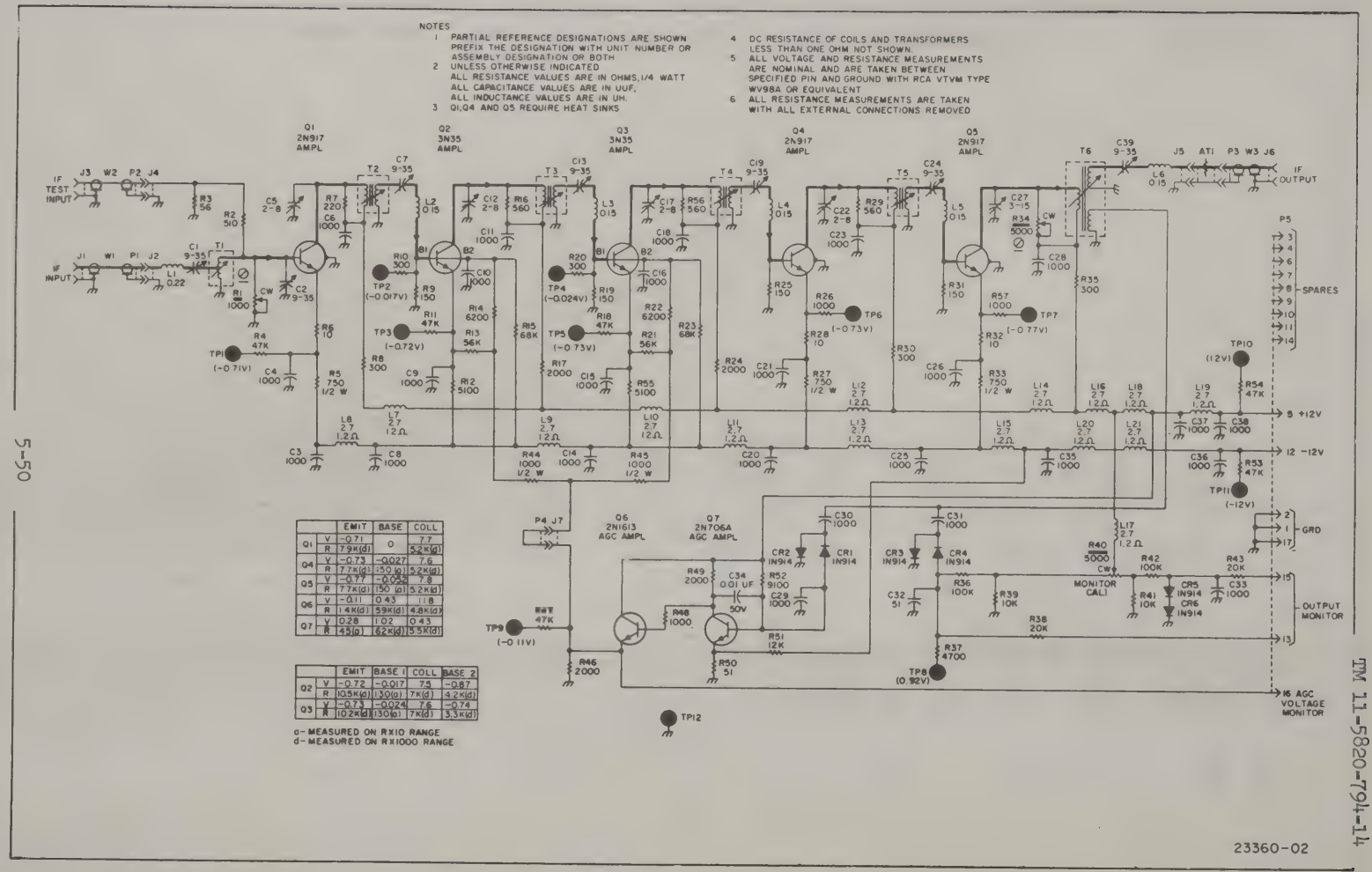
FIGURE 5—32. FREQUENCY CONVERTER, SCHEMATIC DIAGRAM.

NOTE:
PARTIAL REFERENCE DESIGNATIONS ARE SHOWN.
PREFIX THE DESIGNATION WITH UNIT NUMBER OR
ASSEMBLY DESIGNATION OR BOTH.



23641-02

FIGURE 5—33. FRONT PANEL ASSEMBLY, SCHEMATIC DIAGRAM.



		EMIT	BASE	COLL
Q1	V	-0.71	0	7.7
	R	7.9K(d)		5.2K(d)
Q4	V	-0.73	-0.027	7.6
	R	7.7K(d)	150 (d)	5.2K(d)
Q5	V	-0.77	-0.032	7.8
	R	7.7K(d)	150 (d)	5.2K(d)
Q6	V	-0.11	0.43	1.18
	R	1.4K(d)	59K(d)	4.8K(d)
Q7	V	0.28	1.02	0.43
	R	45(a)	62K(d)	5.5K(d)

		EMIT	BASE 1	COLL	BASE 2
Q2	V	-0.72	-0.017	7.5	-0.87
	R	10.5K(d)	130(a)	7K(d)	4.2K(d)
Q3	V	-0.73	-0.024	7.6	-0.74
	R	10.2K(d)	130(a)	7K(d)	3.3K(d)

a- MEASURED ON RX10 RANGE
d- MEASURED ON RX1000 RANGE

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FIGURE 5-34. IF AMPLIFIER (1), SCHEMATIC DIAGRAM.

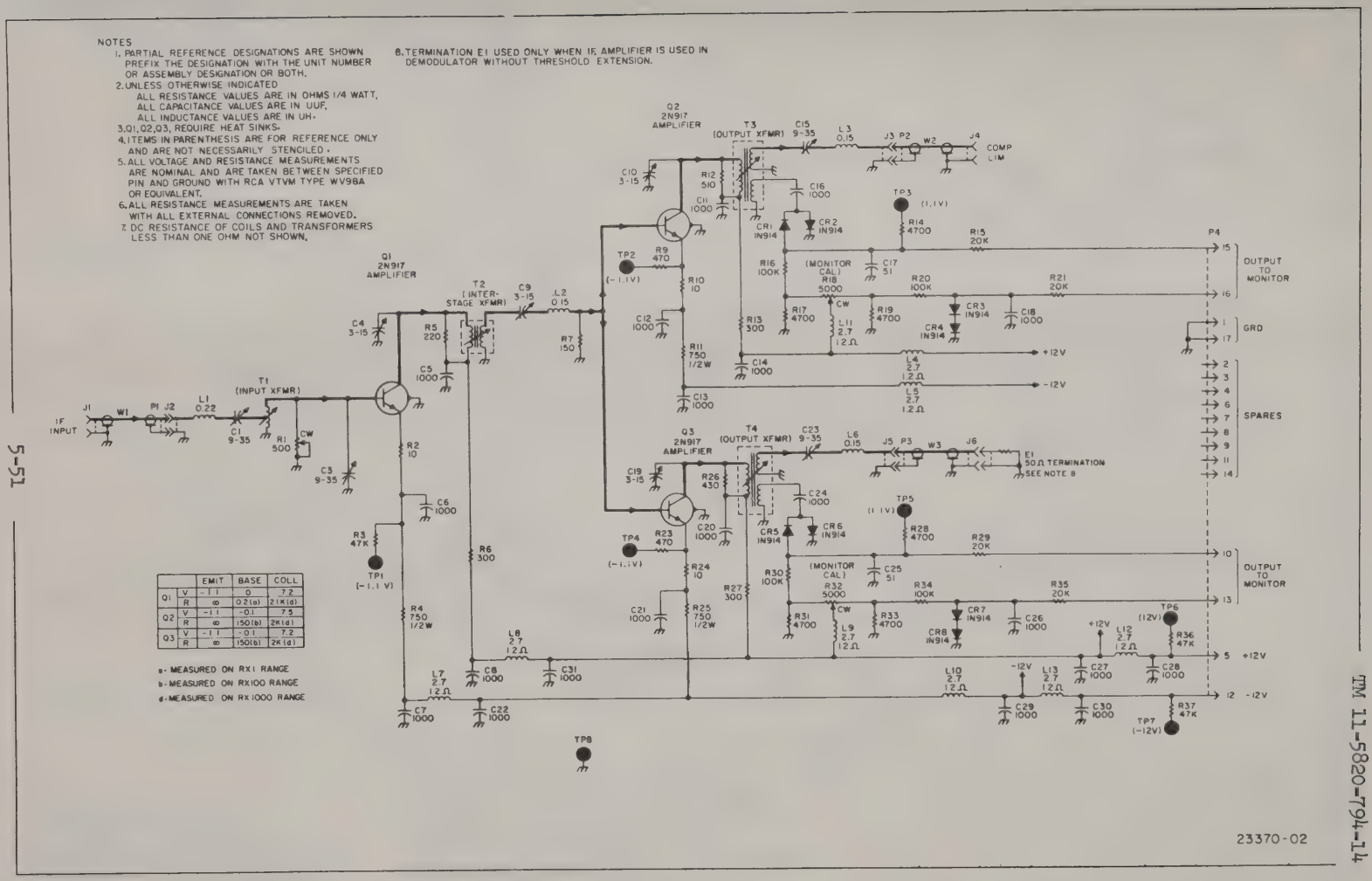


FIGURE 5—35. IF AMPLIFIER (2), SCHEMATIC DIAGRAM.

NOTES (CONTD)

4- ALL VOLTAGE AND RESISTANCE MEASUREMENTS TAKEN BETWEEN SPECIFIED PIN AND GROUND WITH VTVM.

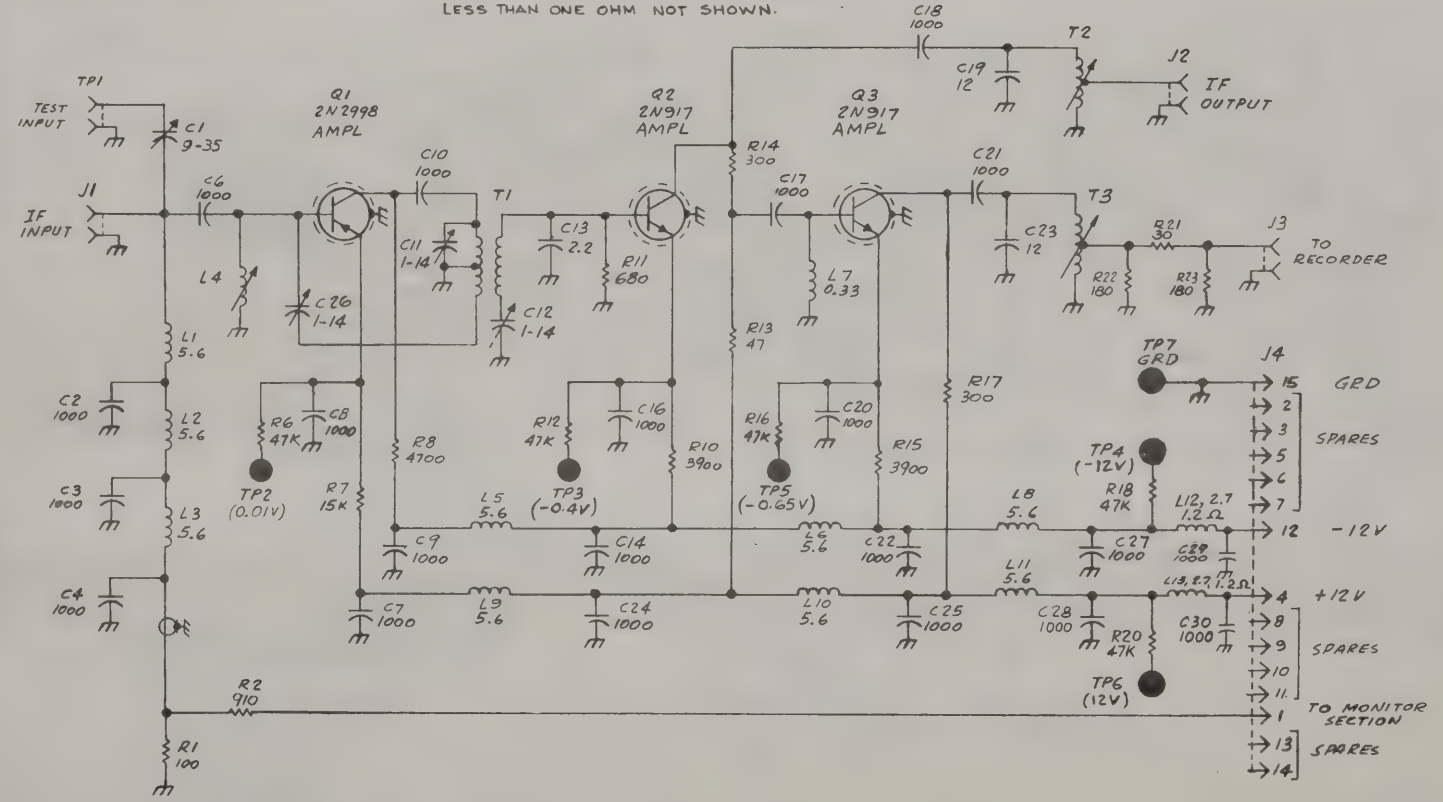
5- ALL RESISTANCE MEASUREMENTS TAKEN WITH ALL EXTERNAL CONNECTIONS REMOVED.

NOTES:

1- UNLESS OTHERWISE INDICATED:
ALL RESISTANCE VALUES ARE IN OHMS, 1/4 WATT,
ALL CAPACITANCE VALUES ARE IN UUF,
ALL INDUCTANCE VALUES ARE IN UH.

2- ALL TRANSISTORS REQUIRE HEAT SINK.

3- DC RESISTANCE OF COILS & TRANSFORMERS LESS THAN ONE OHM NOT SHOWN.



		EMIT	BASE	COLL
Q1	V	0.01	0	-7.8
	R	2K (a)	0	1.2K (a)
Q2	V	-.76	-.04	+10.6
	R	11K (a)	670 (a)	20k (a)
Q3	V	-.73	0	+10.7
	R	11k (a)	0	20k (a)

a - MEASURED ON R×1

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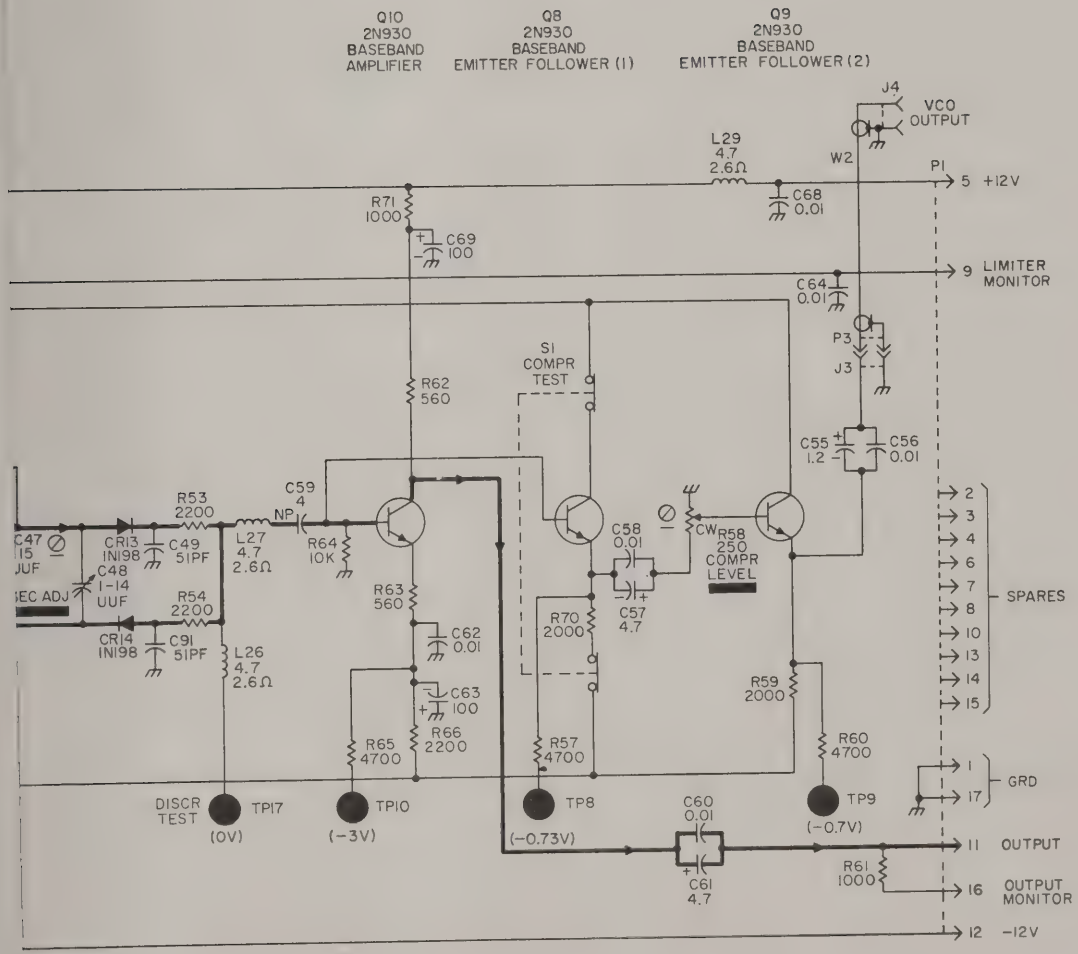
5-52

EMBLY

D ARE

D
T.
L

N ONE OHM NOT SHOWN.



3

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NOTES (CONT'D)

4 - ALL VOLTAGE AND RESISTANCE MEASUREMENTS TAKEN BETWEEN SPECIFIED PIN AND GROUND WITH VTVM.

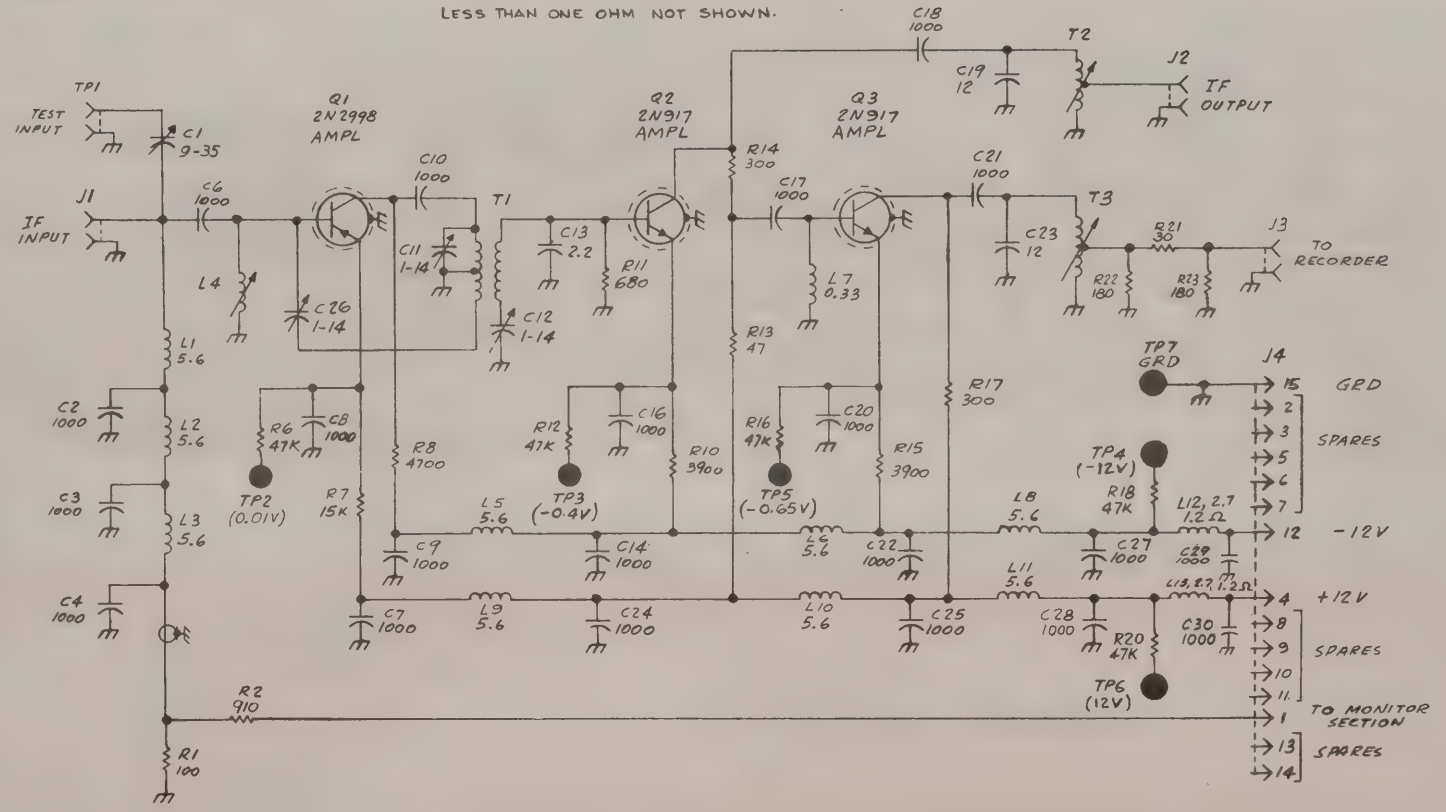
5 - ALL RESISTANCE MEASUREMENTS TAKEN WITH ALL EXTERNAL CONNECTIONS REMOVED.

NOTES:

1 - UNLESS OTHERWISE INDICATED:
ALL RESISTANCE VALUES ARE IN OHMS, 1/4 WATT,
ALL CAPACITANCE VALUES ARE IN UUF,
ALL INDUCTANCE VALUES ARE IN UH.

2 - ALL TRANSISTORS REQUIRE HEAT SINK.

3 - DC RESISTANCE OF COILS & TRANSFORMERS LESS THAN ONE OHM NOT SHOWN.



		EMIT	BASE	COLL
Q1	V	0.01	0	-7.8
	R	2K (a)	0	1.2K (a)
Q2	V	-.76	-0.4	+10.6
	R	11K (a)	670 (b)	20K (a)
Q3	V	-.73	0	+10.7
	R	11K (a)	0	20K (a)

a - MEASURED ON R×1
b - MEASURED ON R×100

23330-02

FIGURE 5—36. IF PREAMPLIFIER, SCHEMATIC DIAGRAM.

		EMIT	BASE	COLL
Q1	V	−0.75	0	9.8
	R	∞	32 (b)	6.6K(d)
Q2	V	−0.73	0	9.8
	R	∞	0.8(a)	6.4K(d)
Q3	V	−0.73	0	9.8
	R	∞	0.8 (a)	6.8K (d)
Q4	V	−0.73	0	9.8
	R	∞	0.8 (a)	7K (d)
Q5	V	−0.75	0	9.8
	R	∞	0.8 (a)	7K (d)
Q6	V	−0.74	0	9
	R	∞	0.2 (a)	6.9K (d)

		EMIT	BASE	COLL
Q7	V	−0.76	0	7.3
	R	∞	0.3 (a)	6.8K(d)
Q8	V	−0.73	−0.19	11.2
	R	∞	10K(d)	6.8K(d)
Q9	V	−0.7	0(f)	11.2(f)
	R	∞	240(e)	6.8K(d)
Q10	V	−3	−0.19	5.8
	R	∞	10K(d)	9K(d)
Q11	V	−0.74	0	7.3
	R	∞	0.3 (a)	6.8K(d)

a− MEASURED ON RX1 RANGE
b− MEASURED ON RX10 RANGE
d− MEASURED ON RX1000 RANGE
e− COMPR LEVEL R58 FULLY CW
f− COMPR LEVEL R58 FULLY CCW

NOTES:
1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. PREFIX THE DESIGNATION WITH UNIT NUMBER OR ASSEMBLY DESIGNATION OR BOTH.
2. UNLESS OTHERWISE INDICATED
   ALL RESISTANCE VALUES ARE IN OHMS, 1/4 WATT.
   ALL CAPACITANCE VALUES ARE IN UF.
   ALL INDUCTANCE VALUES ARE IN UH.
3. ITEMS IN PARENTHESIS ARE FOR REFERENCE ONLY AND ARE NOT NECESSARILY STENCILED.
4. ALL VOLTAGE AND RESISTANCE MEASUREMENTS ARE NOMINAL AND ARE TAKEN BETWEEN SPECIFIED PIN AND GROUND WITH RCA VTVM TYPE WV98A OR EQUIVALENT.
5. ALL RESISTANCE MEASUREMENTS ARE TAKEN WITH ALL EXTERNAL CONNECTIONS REMOVED.
6. DC RESISTANCE OF COILS AND TRANSFORMERS LESS THAN ONE OHM NOT SHOWN.

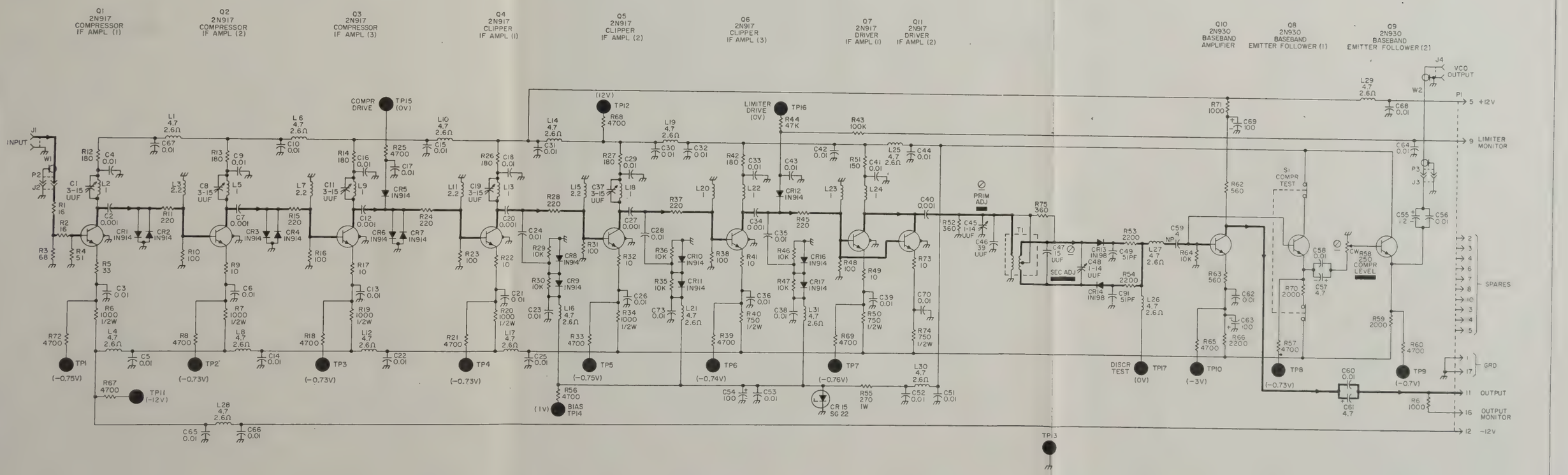
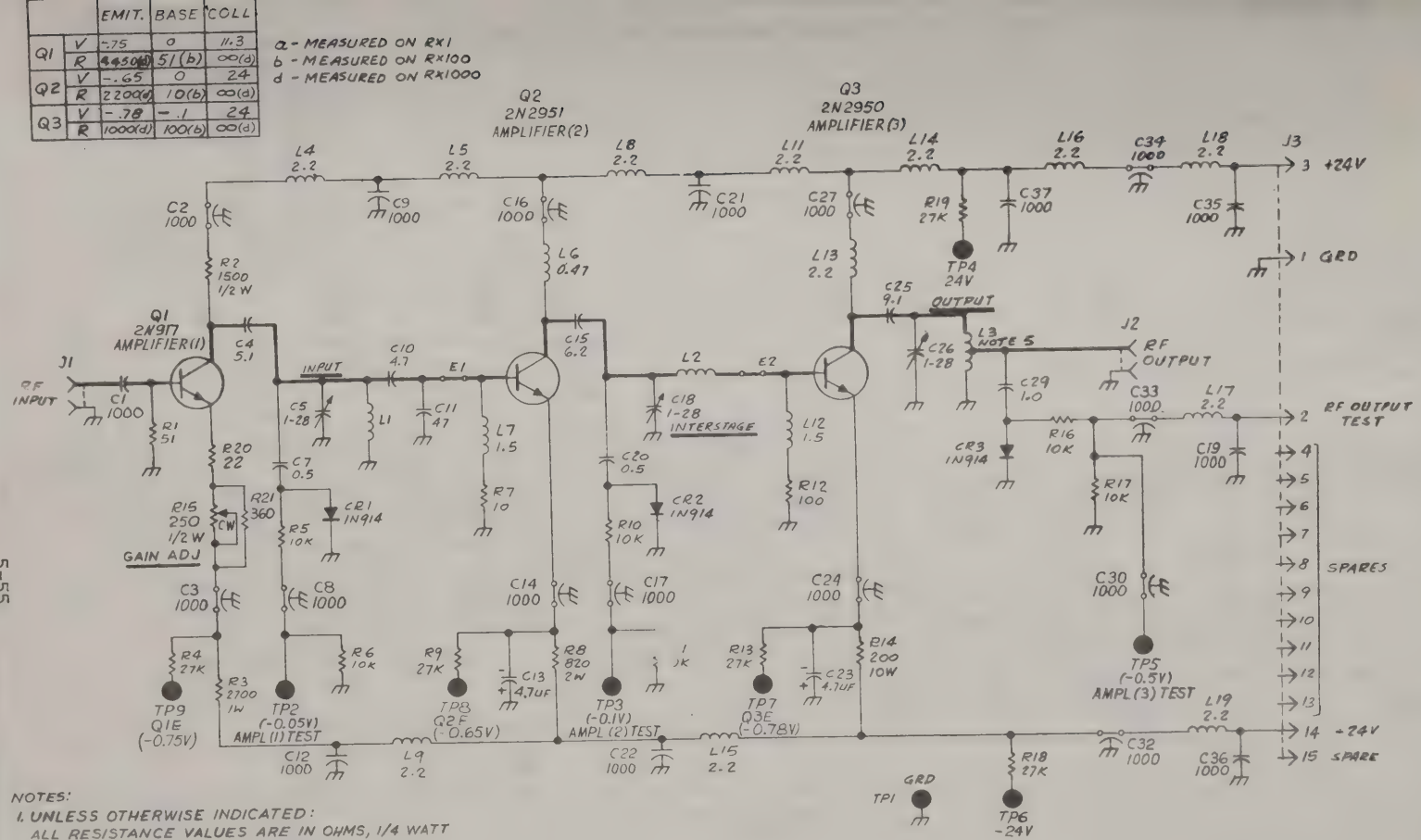


FIGURE 5—37. LIMITERS—DISCRIMINATOR, TYPE 1130, SCHEMATIC DIAGRAM.

23420-02



NOTES:

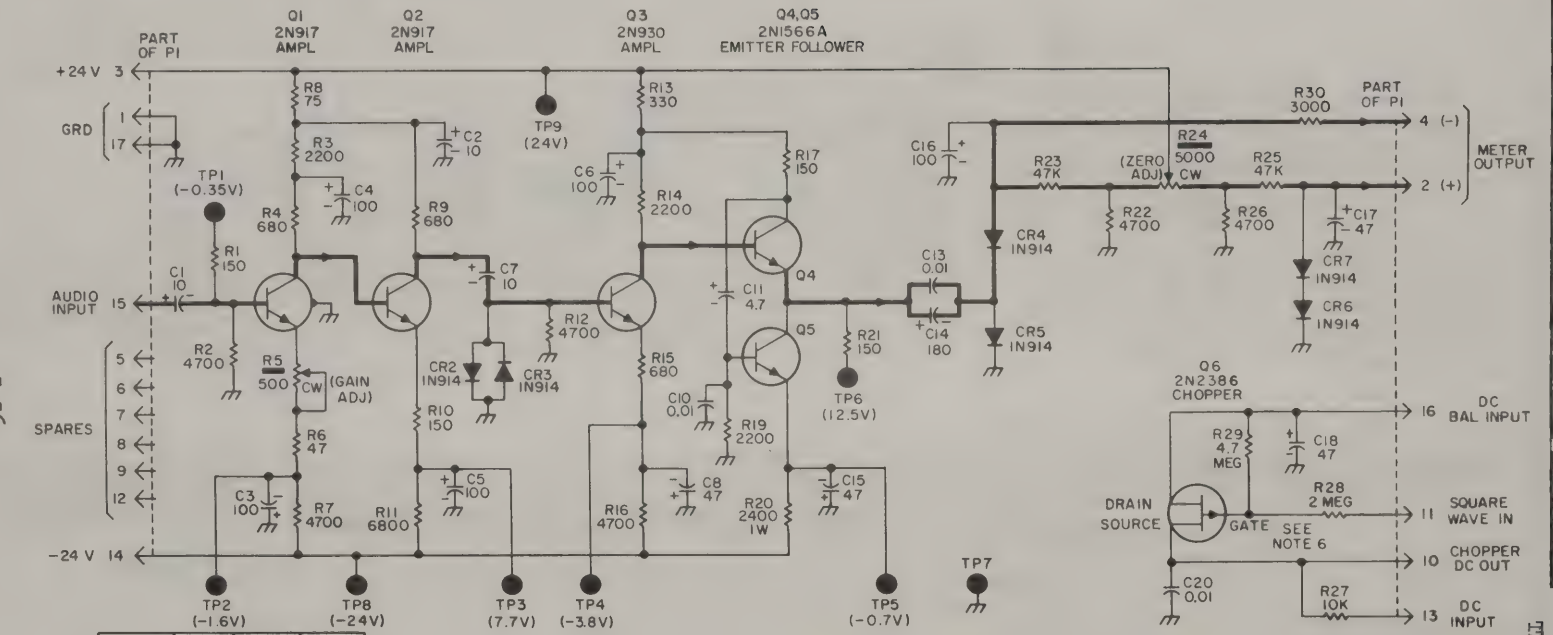
1. UNLESS OTHERWISE INDICATED:
   ALL RESISTANCE VALUES ARE IN OHMS, 1/4 WATT
   ALL CAPACITANCE VALUES ARE IN UUF
   ALL INDUCTANCE VALUES ARE IN UH.
2. ALL VOLTAGE AND RESISTANCE MEASUREMENTS TAKEN BETWEEN SPECIFIED PIN AND GROUND(TP1) WITH VTVM.
3. ALL RESISTANCE MEASUREMENTS TAKEN WITH ALL EXTERNAL CONNECTIONS REMOVED.
4. DC RESISTANCE OF COILS LESS THAN ONE OHM NOT SHOWN.
5. CENTER TAP OF L3 MUST BE A DIRECT CONNECTION TO J2.
6. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. PREFIX THE DESIGNATIONS WITH UNIT NUMBER OR ASSEMBLY DESIGNATION OR BOTH.

22980-02

FIGURE 5—38. LOW FREQUENCY AMPLIFIER, SCHEMATIC DIAGRAM.

NOTES:

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. PREFIX THE DESIGNATION WITH UNIT NUMBER OR ASSEMBLY DESIGNATION OR BOTH.
2. UNLESS OTHERWISE INDICATED ALL RESISTANCE VALUES ARE IN OHMS, 1/2 WATT, ALL CAPACITANCE VALUES ARE IN UF.
3. ITEMS IN PARENTHESIS ARE FOR REFERENCE ONLY AND ARE NOT NECESSARILY STENCILED.
4. ALL VOLTAGE AND RESISTANCE MEASUREMENTS ARE NOMINAL AND ARE TAKEN BETWEEN SPECIFIED PIN AND GROUND WITH RCA VTVM TYPE WV98A OR EQUIVALENT.
5. ALL RESISTANCE MEASUREMENTS ARE TAKEN WITH ALL EXTERNAL CONNECTIONS REMOVED.
6. C21 NOT USED FOR 22770, 22771 AND 22772 ASSEMBLIES.



		EMIT	BASE	COLL
Q1	V	-1.1	-0.35	9.1
	R	∞	4.7K	6.1K
Q2	V	8.4	9.1	20
	R	∞	6.1K	4K
Q3	V	-0.8	-0.35	13.5
	R	∞	4.7K	5.6K
Q4	V	12.5	13.5	22
	R	∞	5.5K	3.3K
Q5	V	-0.7	-0.1	12.5
	R	∞	2.2K	∞
		SOURCE	GATE	DRAIN
Q6	V	0	0	0
	R	∞	∞	∞

FIGURE 5—39. METER AMPLIFIER AND DETECTOR, SCHEMATIC DIAGRAM.

23090-02

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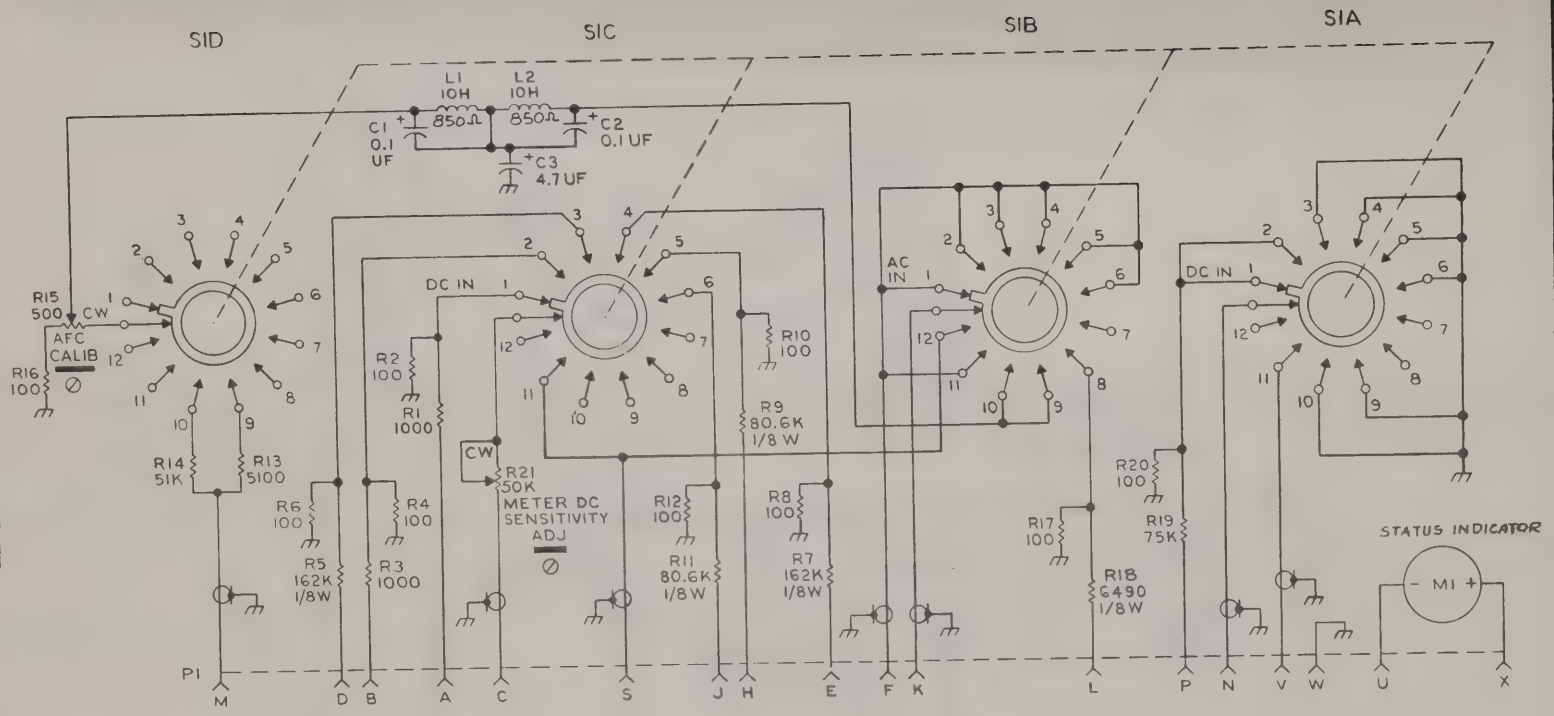
UNLESS OTHERWISE INDICATED:
ALL RESISTANCE VALUES ARE IN OHMS, 1/4 WATT.



POS	FUNCTION	COLOR
1	BASEBAND COMB. CURRENT	
2	ORDER WIRE COMB. CURRENT	
3	+24 VDC	GRN
4	-24 VDC	GRN
5	+12 VDC	GRN
6	-12 VDC	GRN
7	SPARE	
8	BB AMPLIFIER OUTPUT	GRN
9	AFC FS = 1.0 KC	
10	AFC FS = 10.0 KC	
11	TEST POINTS DC	
12	TEST POINTS AC	

23611-02

FIGURE 5—40. METER AND SWITCH ASSEMBLY, SCHEMATIC DIAGRAM.

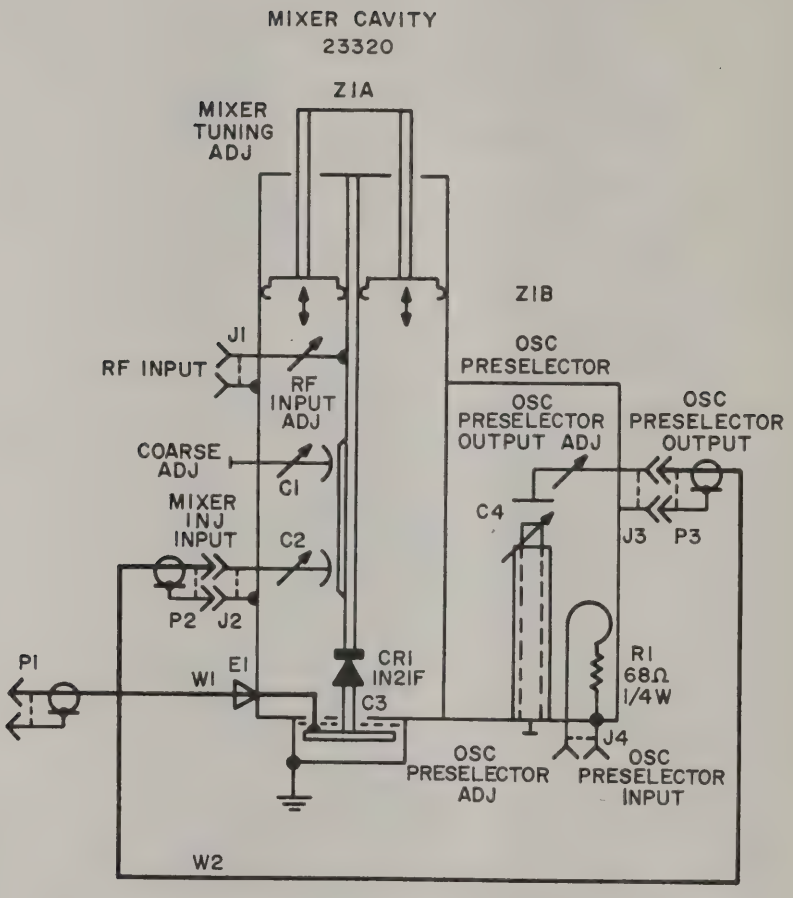
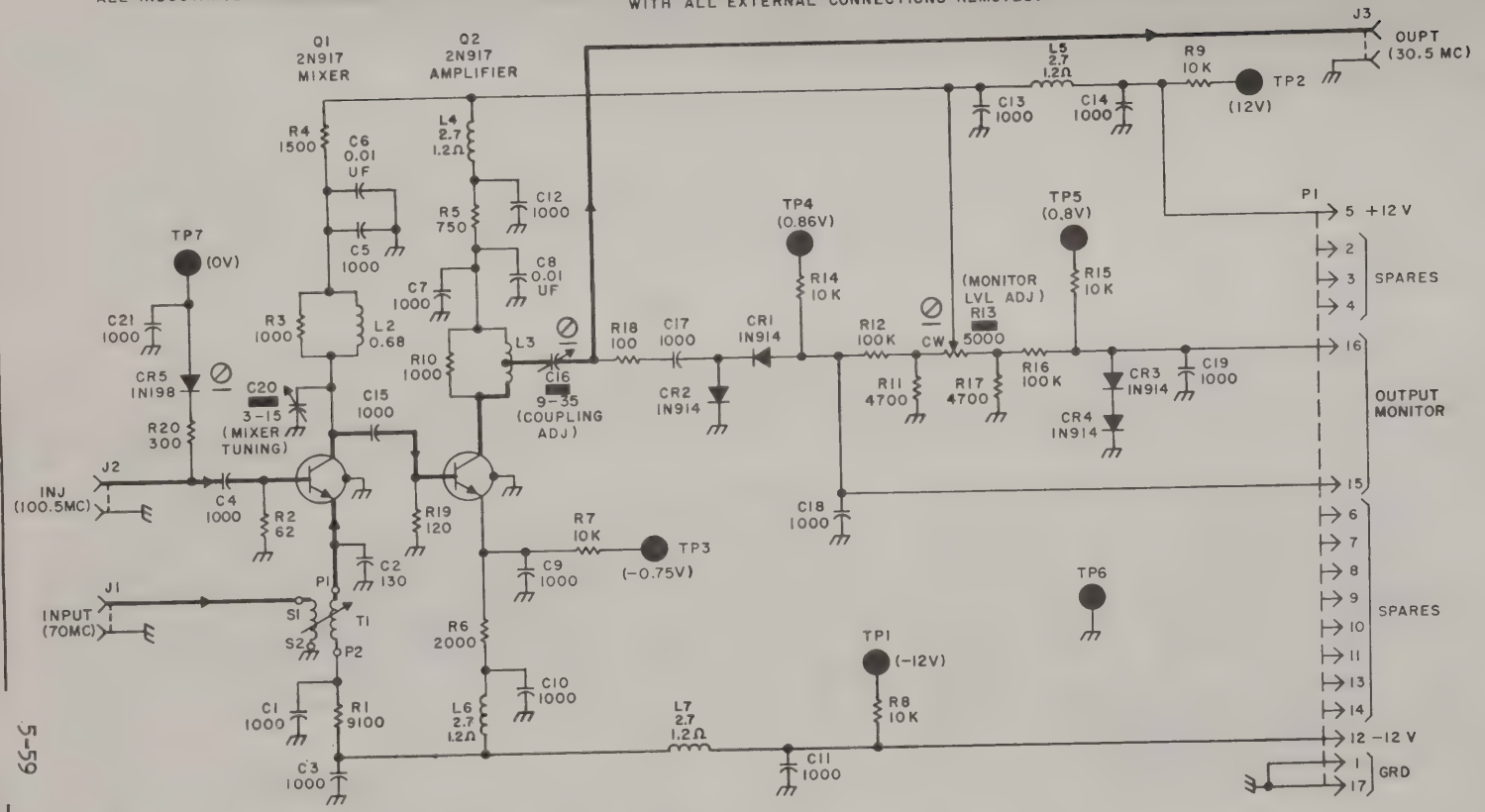


FIGURE 5—41. MIXER CAVITY, SCHEMATIC DIAGRAM.

NOTES:

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. PREFIX THE DESIGNATION WITH UNIT NUMBER OR ASSEMBLY DESIGNATION OR BOTH.
2. UNLESS OTHERWISE INDICATED:
   ALL RESISTANCE VALUES ARE IN OHMS, 1/4 W.
   ALL CAPACITANCE VALUES ARE IN UUF.
   ALL INDUCTANCE VALUES ARE IN UH.
3. DC RESISTANCE OF COILS AND TRANSFORMERS LESS THAN ONE OHM NOT SHOWN.
4. ALL VOLTAGE AND RESISTANCE MEASUREMENTS ARE NOMINAL AND ARE TAKEN BETWEEN SPECIFIED PIN AND GROUND WITH RCA VTVM TYPE WV98A OR EQUIVALENT.
5. ALL RESISTANCE MEASUREMENTS ARE TAKEN WITH ALL EXTERNAL CONNECTIONS REMOVED.



		EMIT	BASE	COLL
Q1	V	-0.72	0	10.2
	R	∞	66(a)	5.3K(d)
Q2	V	-0.75	0	7.8
	R	∞	120(b)	4.5K(d)

a- MEASURED ON RX10 RANGE
b- MEASURED ON RX100 RANGE
d- MEASURED ON RX1000 RANGE

23410-02

FIGURE 5-42. MIXER (DEMODULATOR), TYPE 1130, SCHEMATIC DIAGRAM.

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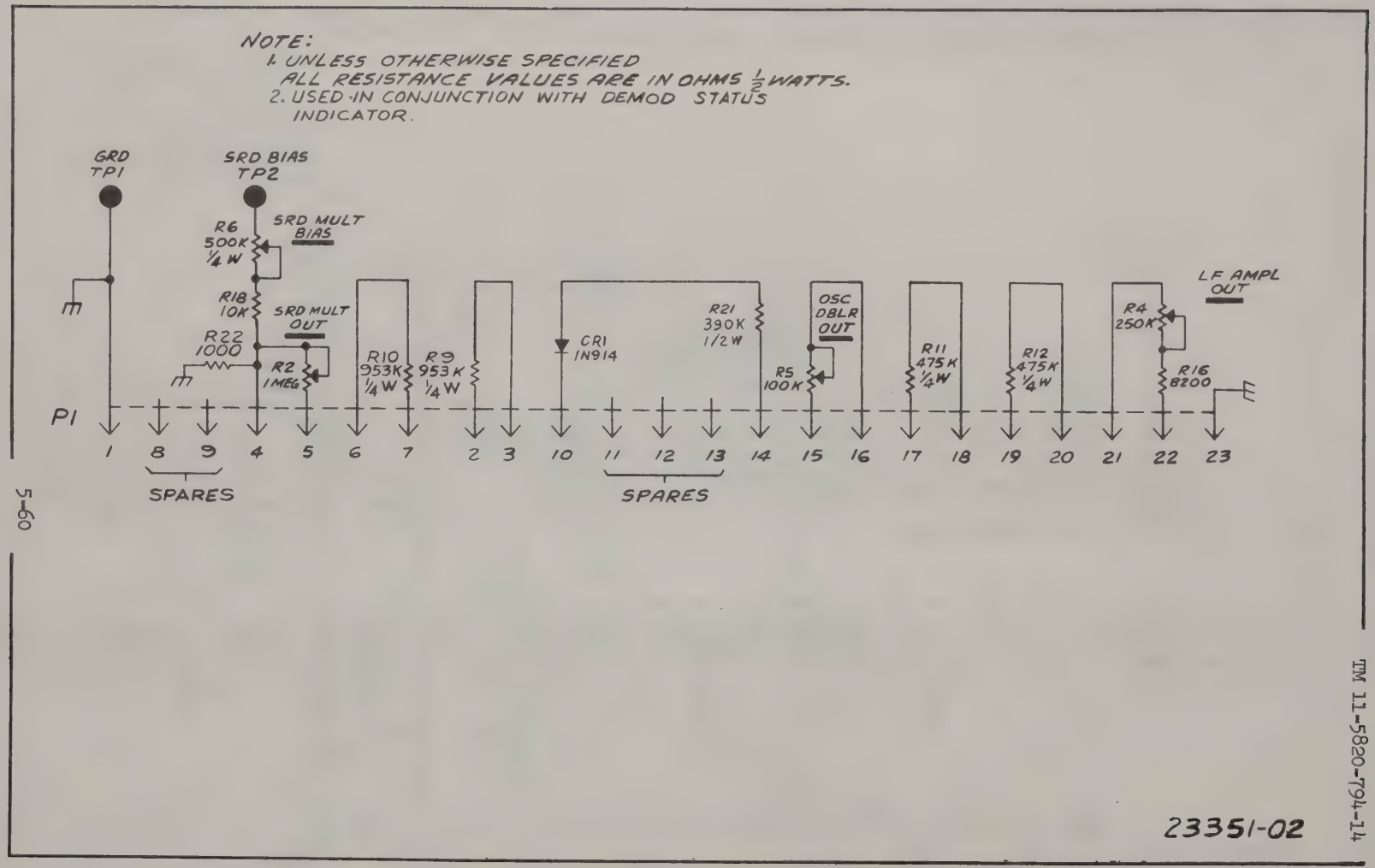


FIGURE 5—43. MONITOR CONTROL (FREQUENCY CONVERTER), SCHEMATIC DIAGRAM.

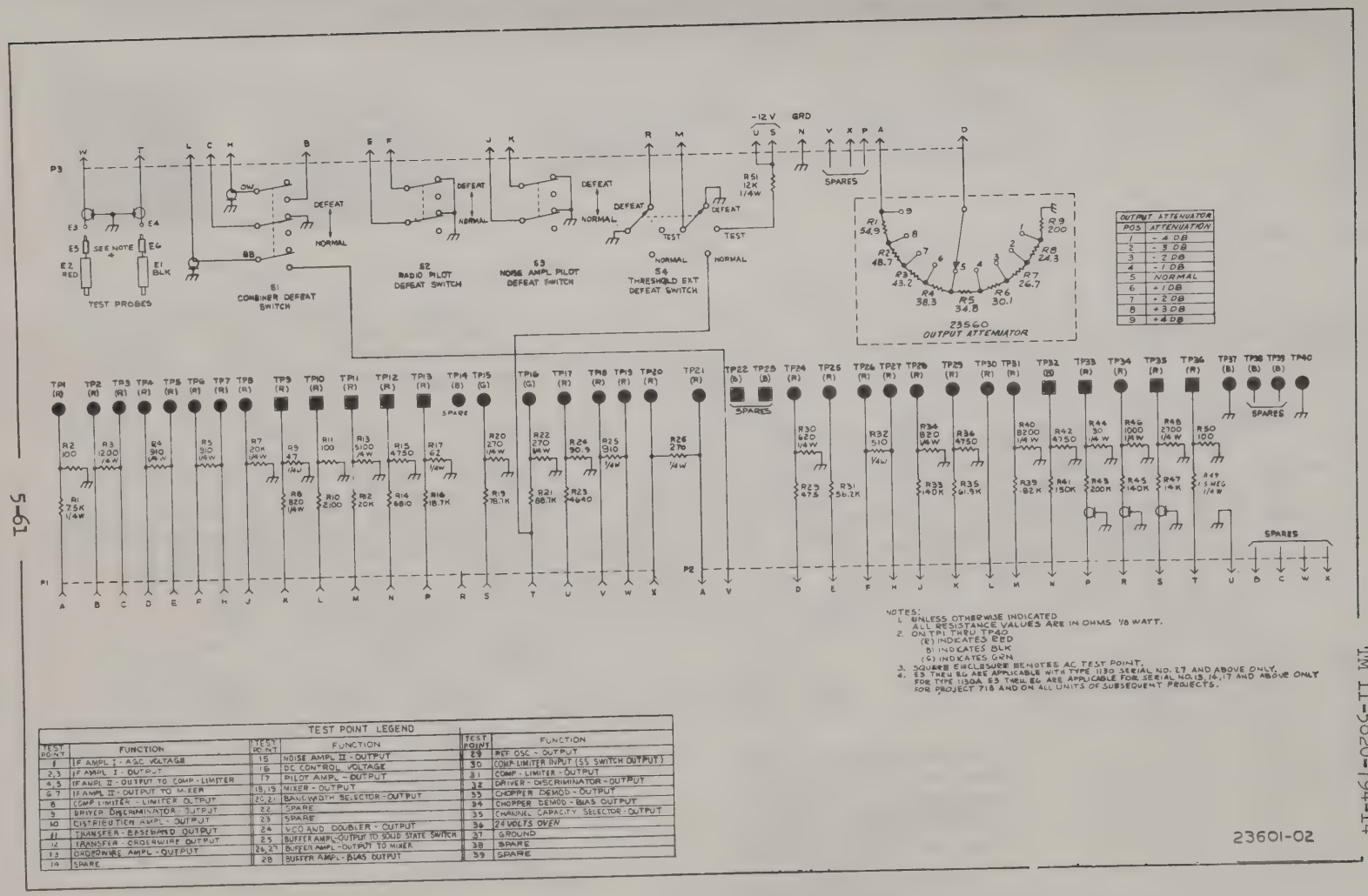
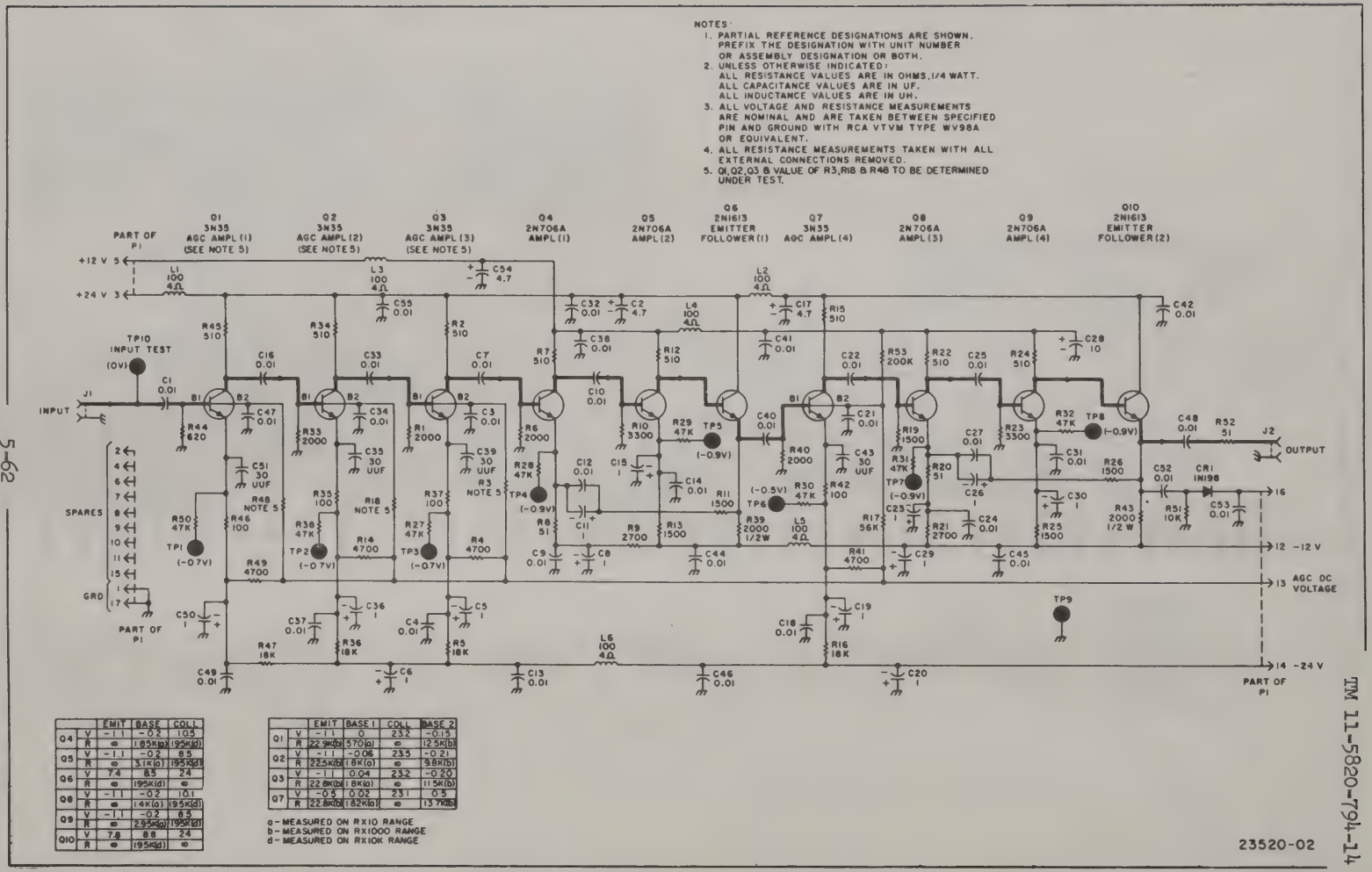


FIGURE 5—44. MONITOR CONTROL SECTION (DEMODULATOR), SCHEMATIC DIAGRAM.

TM 11-5820-794-14

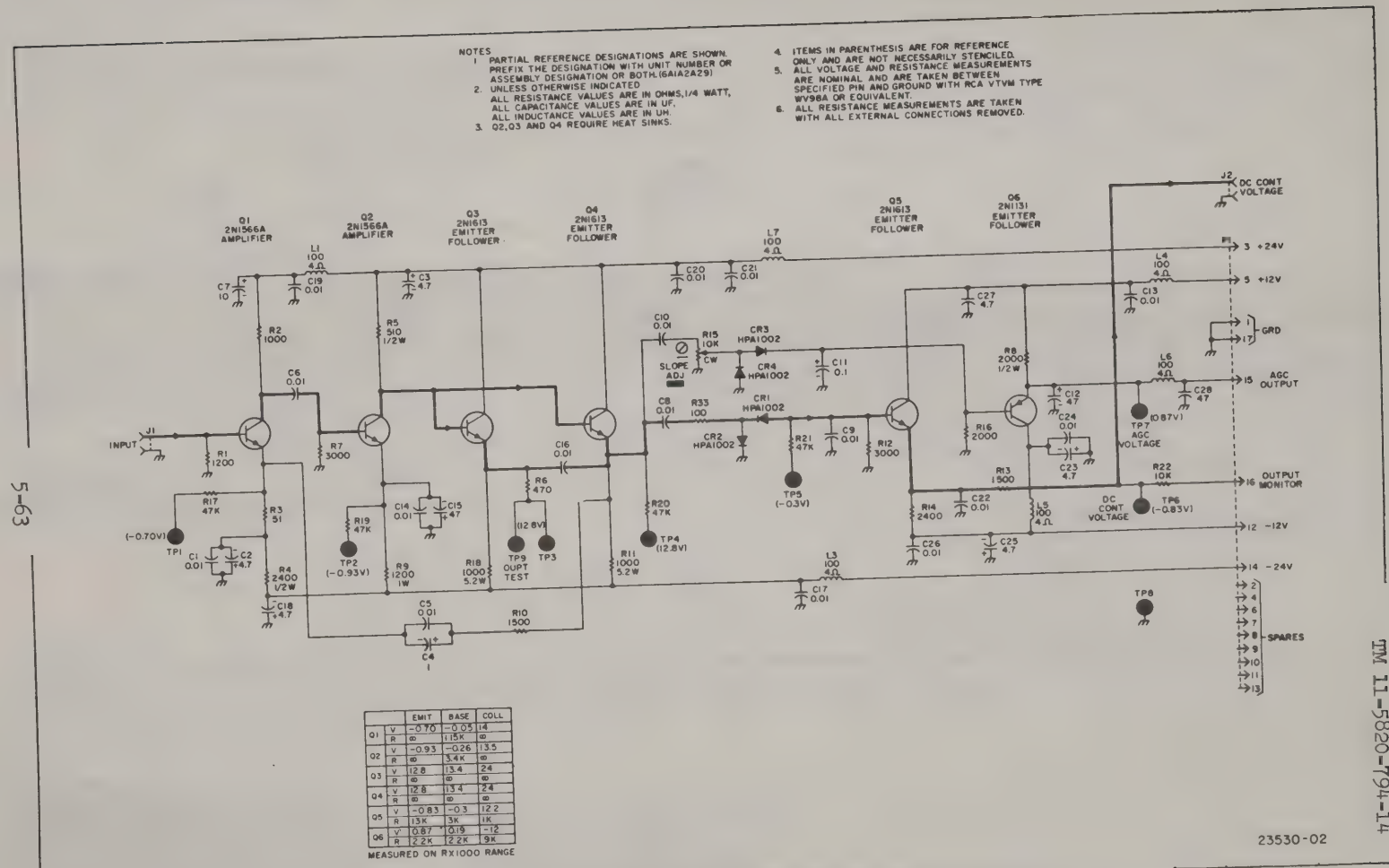


		EMIT	BASE	COLL
Q4	V	-1.1	-0.2	10.5
	R	∞	185K(a)	195K(d)
Q5	V	-1.1	-0.2	8.5
	R	∞	3.1K(a)	195K(d)
Q6	V	7.4	8.5	24
	R	∞	195K(d)	∞
Q8	V	-1.1	-0.2	10.1
	R	∞	1.4K(a)	195K(d)
Q9	V	-1.1	-0.2	8.5
	R	∞	235K(a)	195K(d)
Q10	V	7.8	8.8	24
	R	∞	195K(d)	∞

		EMIT	BASE 1	COLL	BASE 2
Q1	V	-1.1	0	23.2	-0.15
	R	22.9K(b)	570(a)	∞	12.5K(b)
Q2	V	-1.1	-0.06	23.5	-0.21
	R	225K(b)	1.8K(a)	∞	9.8K(b)
Q3	V	-1.1	0.04	23.2	-0.20
	R	22.8K(b)	1.8K(a)	∞	11.5K(b)
Q7	V	-0.5	0.02	23.1	0.5
	R	22.8K(b)	1.82K(a)	∞	13.7K(b)

a - MEASURED ON RX10 RANGE
b - MEASURED ON RX1000 RANGE
d - MEASURED ON RX10K RANGE

FIGURE 5—45. NOISE AMPLIFIER (1), SCHEMATIC DIAGRAM.



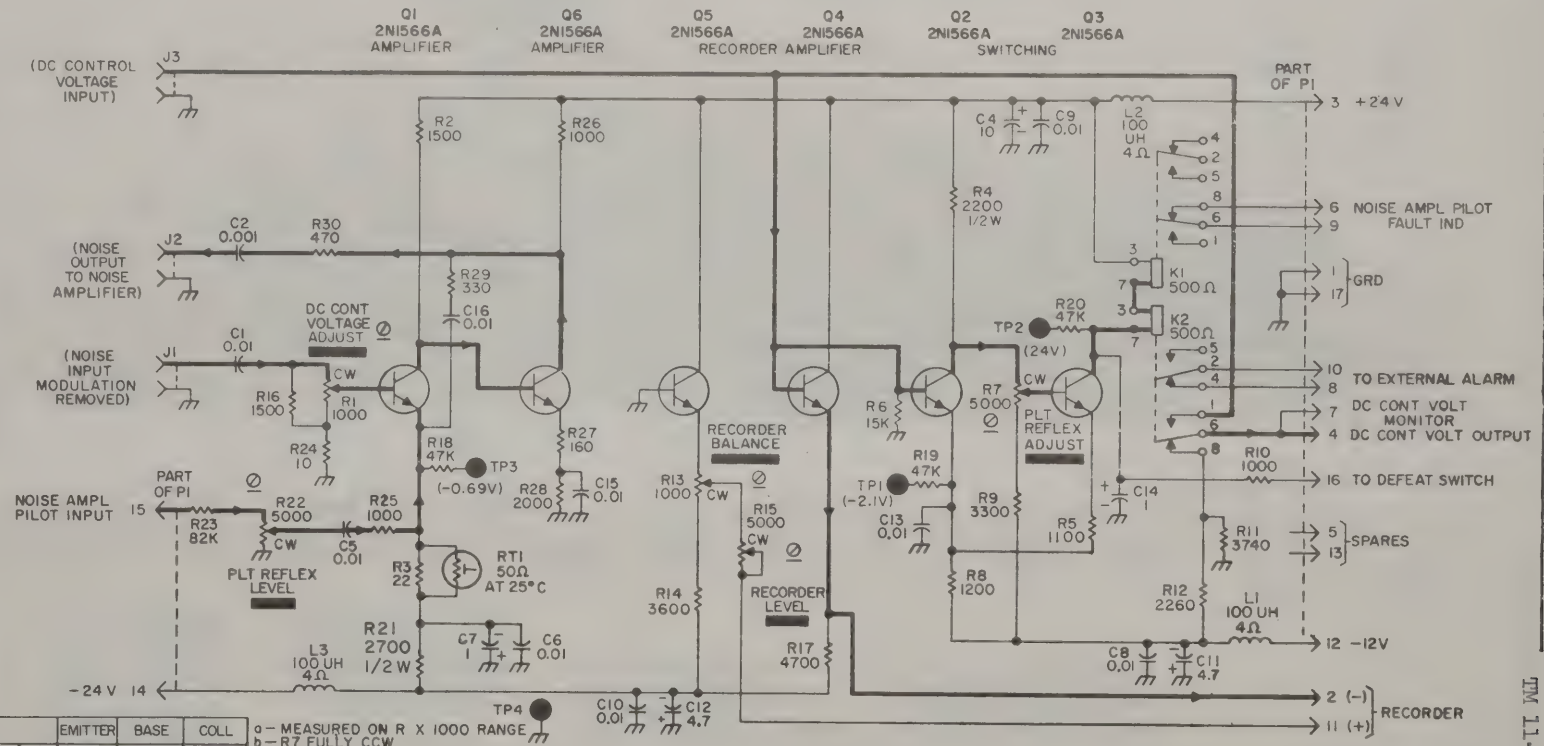
		EMIT	BASE	COLL
Q1	V	-0.70	-0.05	14
	R	∞	1.15K	∞
Q2	V	-0.93	-0.26	13.5
	R	∞	3.4K	∞
Q3	V	12.8	13.4	24
	R	∞	∞	∞
Q4	V	12.8	13.4	24
	R	∞	∞	∞
Q5	V	-0.83	-0.3	12.2
	R	13K	3K	11K
Q6	V	0.87	0.19	-12
	R	2.2K	2.2K	9K

MEASURED ON RX1000 RANGE

FIGURE 5-46. NOISE AMPLIFIER (2), SCHEMATIC DIAGRAM.

NOTES:

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. PREFIX THE DESIGNATION WITH UNIT NUMBER OR ASSEMBLY DESIGNATION OR BOTH. (6A1A2A34)
2. UNLESS OTHERWISE INDICATED ALL RESISTANCE VALUES ARE IN OHMS, 1/4 WATT, ALL CAPACITANCE VALUES ARE IN UF.
3. ITEMS IN PARENTHESIS ARE FOR REFERENCE ONLY AND ARE NOT NECESSARILY STENCILED.
4. ALL VOLTAGE AND RESISTANCE MEASUREMENTS ARE NOMINAL AND ARE TAKEN BETWEEN SPECIFIED PIN AND GROUND WITH RCA VTVM TYPE WV98A OR EQUIVALENT.
5. ALL RESISTANCE MEASUREMENTS ARE TAKEN WITH ALL EXTERNAL CONNECTIONS REMOVED.
6. RELAYS SHOWN IN DE-ENERGIZED POSITION.



		EMITTER	BASE	COLL
Q1	V	-0.69	0	11.3
	R	∞	590(d)	7.5K(a)
Q2	V	-2.1	-1.4	1.1
	R	6.6K(a)	9K(a)	8.2K(a)
Q3	V	-2.1	-2.4	24
	R	7.6K(a)	7.3K(b)	8.7K(a)
Q4	V	-2.1	-1.4	24
	R	∞	9K(a)	7.3K(a)
Q5	V	-0.61	GRD	24
	R	∞		7.3K(a)
Q6	V	10.5	11.3	19
	R	2K(a)	7.5K(a)	7.5K(a)

a – MEASURED ON R X 1000 RANGE
b – R7 FULLY CCW
d – R1 FULLY CCW

BASING DIAGRAM FOR K1 AND K2 (BOTTOM VIEW)

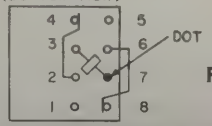


FIGURE 5–47. NOISE AMPLIFIER REFLEX AND RECORDER AMPLIFIER, TYPE 1130, SCHEMATIC DIAGRAM.

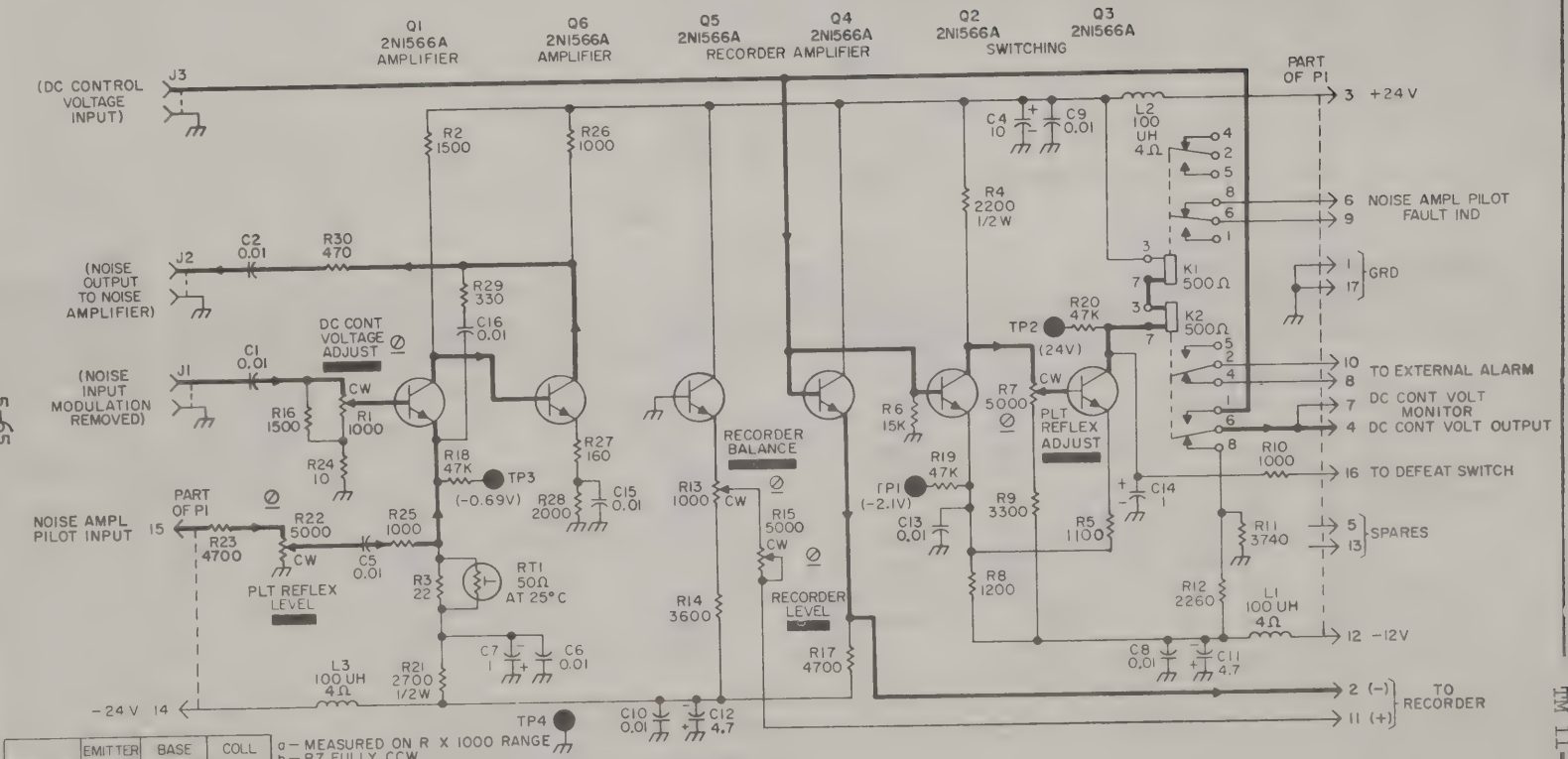
23590-02

5-61

TM 11-5820-794-14

NOTES:

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. PREFIX THE DESIGNATION WITH UNIT NUMBER OR ASSEMBLY DESIGNATION OR BOTH.
2. UNLESS OTHERWISE INDICATED ALL RESISTANCE VALUES ARE IN OHMS, 1/4 WATT, ALL CAPACITANCE VALUES ARE IN UF.
3. ITEMS IN PARENTHESIS ARE FOR REFERENCE ONLY AND ARE NOT NECESSARILY STENCILED.
4. ALL VOLTAGE AND RESISTANCE MEASUREMENTS ARE NOMINAL AND ARE TAKEN BETWEEN SPECIFIED PIN AND GROUND WITH RCA VTVM TYPE WV98A OR EQUIVALENT.
5. ALL RESISTANCE MEASUREMENTS ARE TAKEN WITH ALL EXTERNAL CONNECTIONS REMOVED.
6. RELAYS SHOWN IN DE-ENERGIZED POSITION.



		EMITTER	BASE	COLL
Q1	V	-0.69	0	11.3
	R	∞	590(d)	7.5K(a)
Q2	V	-2.1	-1.4	1.1
	R	6.6K(a)	9K(a)	8.2K(a)
Q3	V	-2.1	-2.4	24
	R	7.6K(a)	7.3K(b)	8.7K(a)
Q4	V	-2.1	-1.4	24
	R	∞	9K(a)	7.3K(a)
Q5	V	-0.61	GRD	24
	R	∞		7.3K(a)
Q6	V	10.5	11.3	19
	R	2K(a)	7.5K(a)	7.5K(a)

a — MEASURED ON R X 1000 RANGE
b — R7 FULLY CCW
d — R1 FULLY CCW

BASING DIAGRAM FOR K1 AND K2 (BOTTOM VIEW)

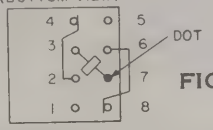
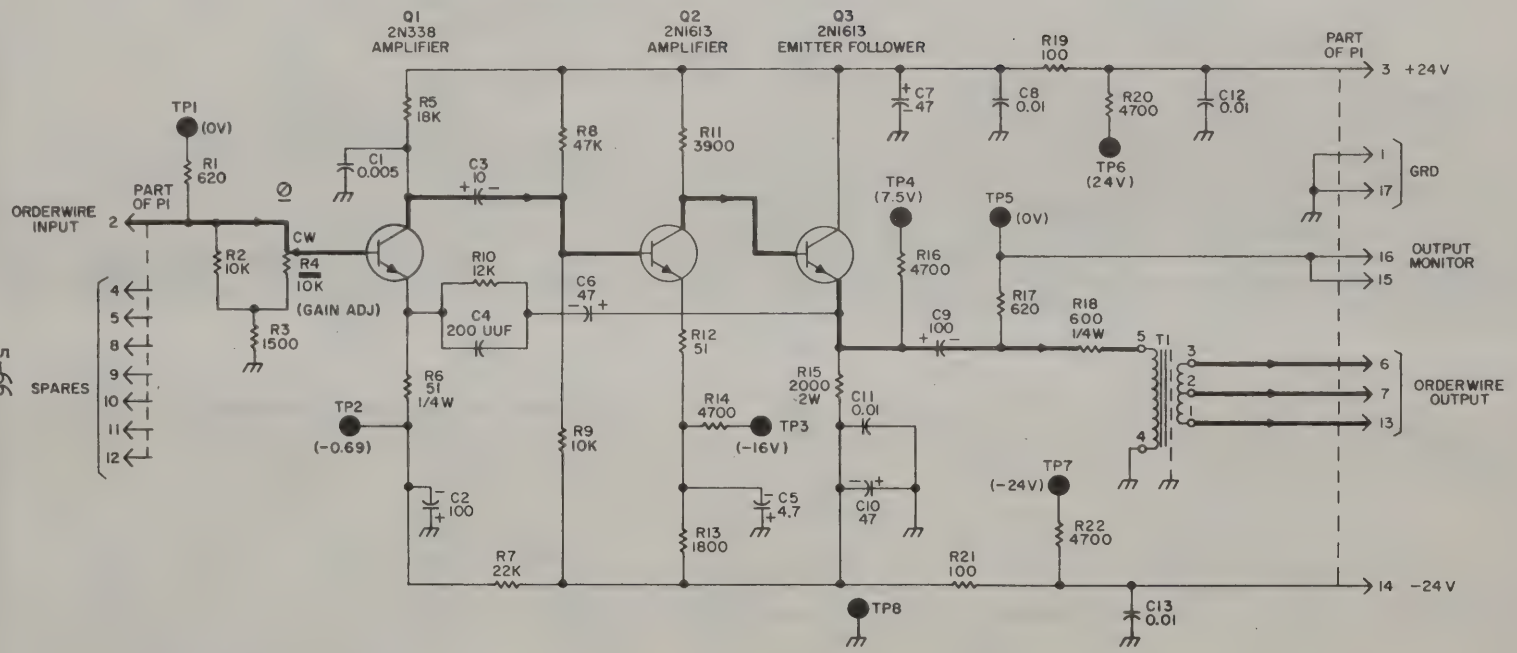


FIGURE 5—48. NOISE AMPLIFIER REFLEX AND RECORDER AMPLIFIER, TYPE 1130A, SCHEMATIC DIAGRAM. 23591-02

TM 11-5820-794-14

NOTES:

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. PREFIX THE DESIGNATION WITH UNIT NUMBER OR ASSEMBLY DESIGNATION OR BOTH.
2. UNLESS OTHERWISE INDICATED ALL RESISTANCE VALUES ARE IN OHMS, 1/2 WATT, ALL CAPACITANCE VALUES ARE IN UF.
3. Q3 REQUIRES HEAT SINK.
4. ITEMS IN PARENTHESIS ARE FOR REFERENCE ONLY AND ARE NOT NECESSARILY STENCILED.
5. ALL VOLTAGE AND RESISTANCE MEASURMENTS ARE NOMINAL AND ARE TAKEN BETWEEN SPECIFIED PIN AND GROUND WITH RCA VTVM TYPE WV98A OR EQUIVALENT.
6. ALL RESISTANCE MEASUREMENTS ARE TAKEN WITH ALL EXTERNAL CONNECTIONS REMOVED.



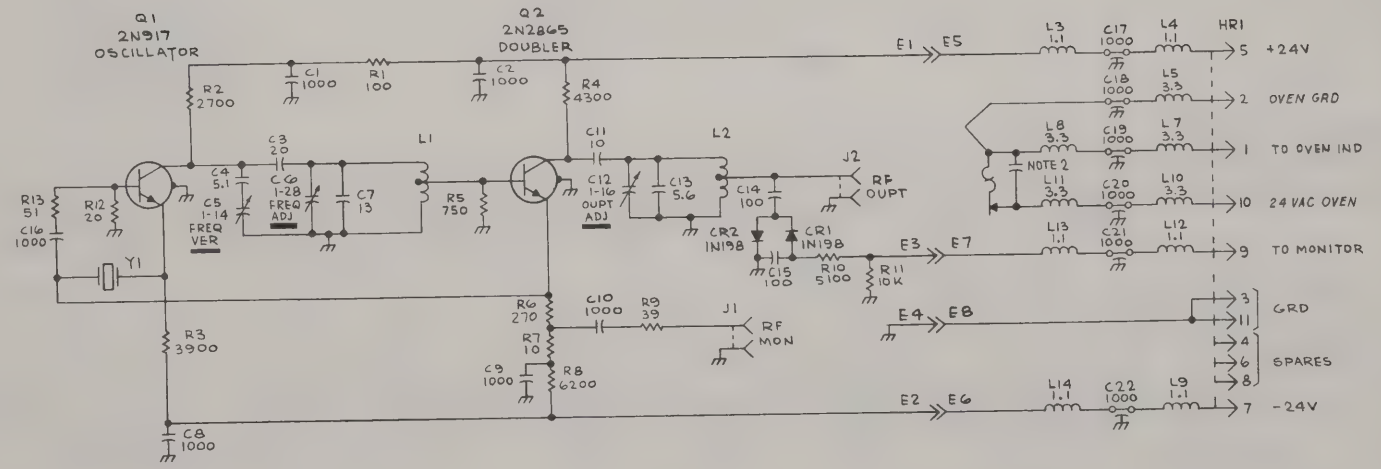
		EMIT	BASE	COLL
Q1	V	-0.69	-0.62	5.8
	R	∞	4.6K	∞
Q2	V	-16	-15	8
	R	∞	∞	∞
Q3	V	7.5	8	22
	R	∞	∞	∞

MEASURED ON RX1000 RANGE

FIGURE 5-49. ORDER WIRE AMPLIFIER, SCHEMATIC DIAGRAM.

23571-02

NOTES:
1 - UNLESS OTHERWISE INDICATED:
ALL RESISTANCE VALUES ARE IN OHMS, 1/4 WATT,
ALL CAPACITANCE VALUES ARE IN UUF,
ALL INDUCTANCE VALUES ARE IN UH
2 - 2000 UUF CAPACITOR IS PART OF OVEN.
3 - ALL VOLTAGE AND RESISTANCE MEASUREMENTS TAKEN BETWEEN SPECIFIED PIN AND GROUND WITH VTVM.
4. ALL RESISTANCE MEASUREMENTS TAKEN WITH ALL EXTERNAL CONNECTIONS REMOVED.
5. D.C. RESISTANCE OF COILS LESS THAN ONE OHM NOT SHOWN.

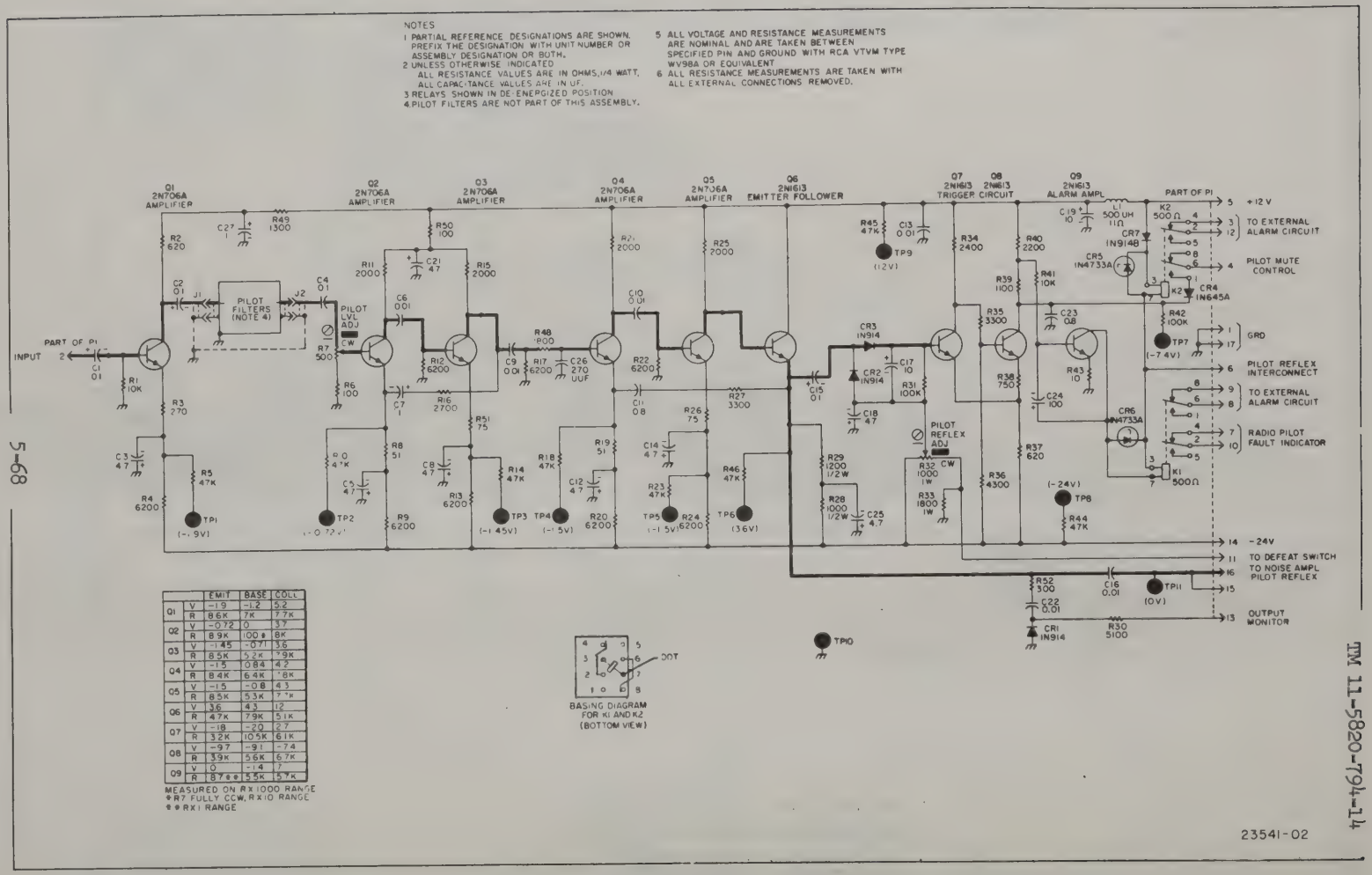


		EMIT	BASE	COLL
Q1	V	-8.0	0	+7.2
	R	∞(d)	20(b)	0(a)
Q2	V	-6.4	0	+14.5
	R	∞(d)	0(a)	∞(d)

a - MEASURED ON Rx1
b - MEASURED ON Rx10
d - MEASURED ON Rx1000

24150-02

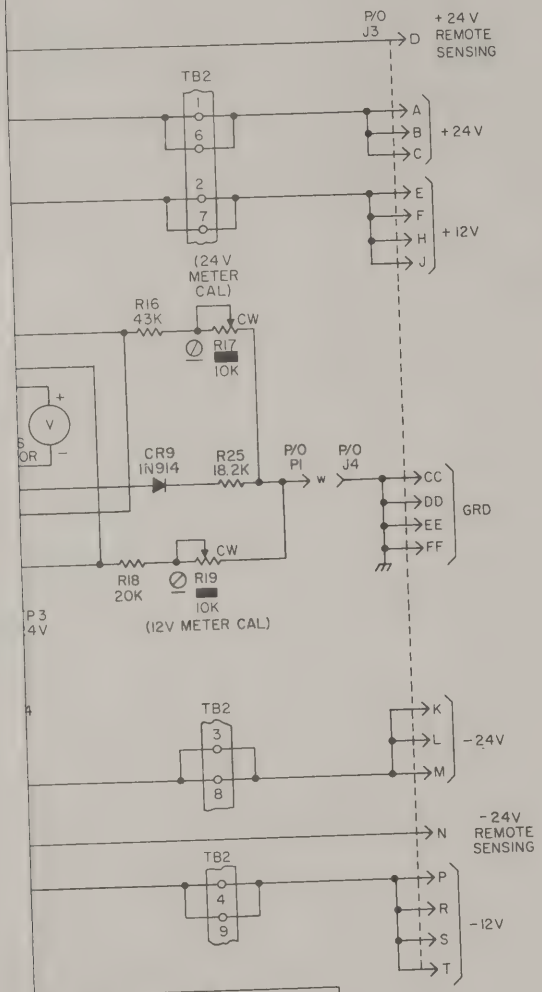
FIGURE 5—50. OSCILLATOR—DOUBLER, SCHEMATIC DIAGRAM.



		EMIT	BASE	COLL
Q1	V	-1.9	-1.2	5.2
	R	86K	7K	7.7K
Q2	V	-.072	0	3.7
	R	89K	100 @	8K
Q3	V	-1.45	-.071	3.6
	R	8.5K	5.2K	7.9K
Q4	V	-1.5	.084	4.2
	R	84K	6.4K	8K
Q5	V	-1.5	-.08	4.3
	R	85K	5.3K	7.7K
Q6	V	3.6	4.3	12
	R	47K	79K	51K
Q7	V	-.18	-.22	2.7
	R	32K	105K	61K
Q8	V	-.97	-.91	-.74
	R	3.9K	56K	6.7K
Q9	V	0	-.14	7
	R	87 @@	55K	5.7K

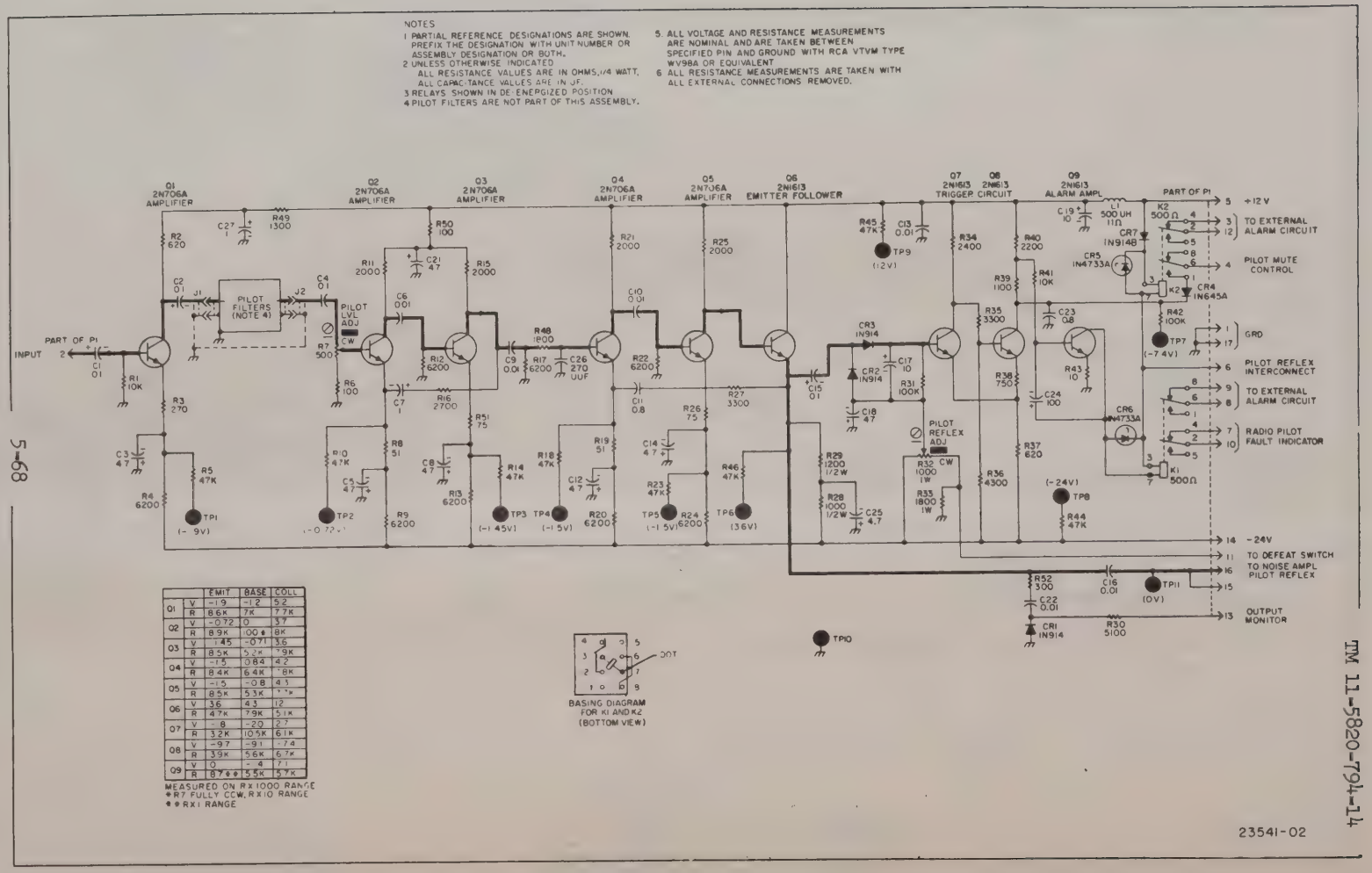
MEASURED ON Rx1000 RANGE
* R7 FULLY CCW, Rx10 RANGE
@@ Rx1 RANGE

FIGURE 5-51. PILOT AMPLIFIER, SCHEMATIC DIAGRAM.



S2 METER SELECTOR SWITCH		
POS	CONTACTS	FUNCTION
1	1 AND 8	24V(OVENS)
2	2 AND 9	+24V
3	3 AND 10	-24V
4	4 AND 11	+12V
5	5 AND 12	-12V

22731-02



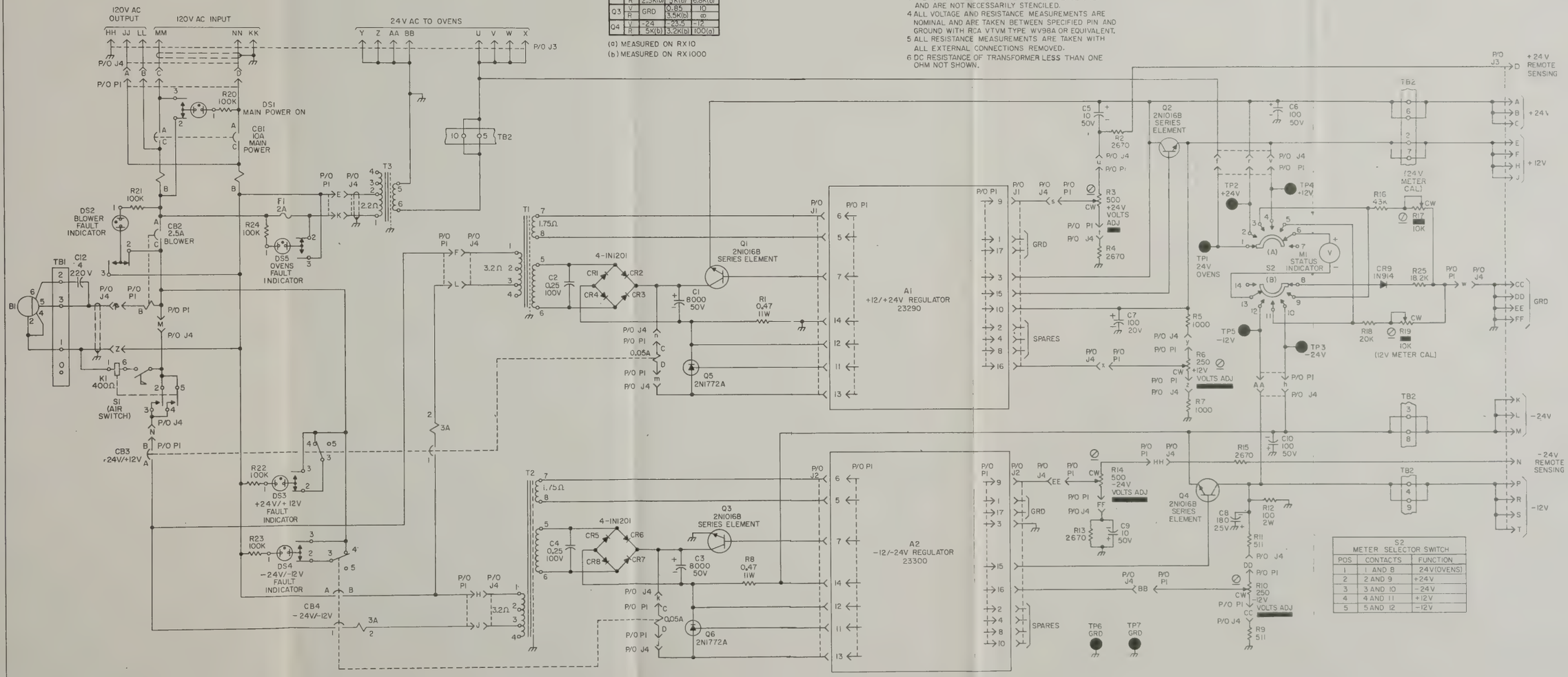
		EMIT	BASE	COLL
Q1	V	-1.9	-1.2	5.2
	R	8.6K	7K	7.7K
Q2	V	-0.72	0	3.7
	R	8.9K	100 ♦	8K
Q3	V	-1.45	-0.71	3.6
	R	8.5K	5.2K	7.9K
Q4	V	-1.5	0.84	4.2
	R	8.4K	6.4K	8K
Q5	V	-1.5	-0.8	4.1
	R	8.5K	5.3K	***K
Q6	V	3.6	4.3	12
	R	47K	7.9K	51K
Q7	V	-.8	-2.0	2.7
	R	3.2K	10.5K	6.1K
Q8	V	-9.7	-9.1	-7.4
	R	3.9K	5.6K	6.7K
Q9	V	0	-.4	7.1
	R	87♦♦	5.5K	5.7K

MEASURED ON Rx1000 RANGE
♦R7 FULLY CCW, Rx10 RANGE
♦♦Rx1 RANGE

5-68

TM 11-5820-794-14

FIGURE 5—51. PILOT AMPLIFIER, SCHEMATIC DIAGRAM.



		EMIT	BASE	COLL
Q1	V	24	25	33.5
	R	6.8K(b)	18K(b)	∞
Q2	V	12	12.2	24
	R	2.3K(b)	5K(b)	6.8K(b)
Q3	V	GRD	0.85	10
	R		3.5K(b)	∞
Q4	V	-24	-23.5	-12
	R	5K(b)	3.2K(b)	100(a)

(a) MEASURED ON RX10
(b) MEASURED ON RX1000

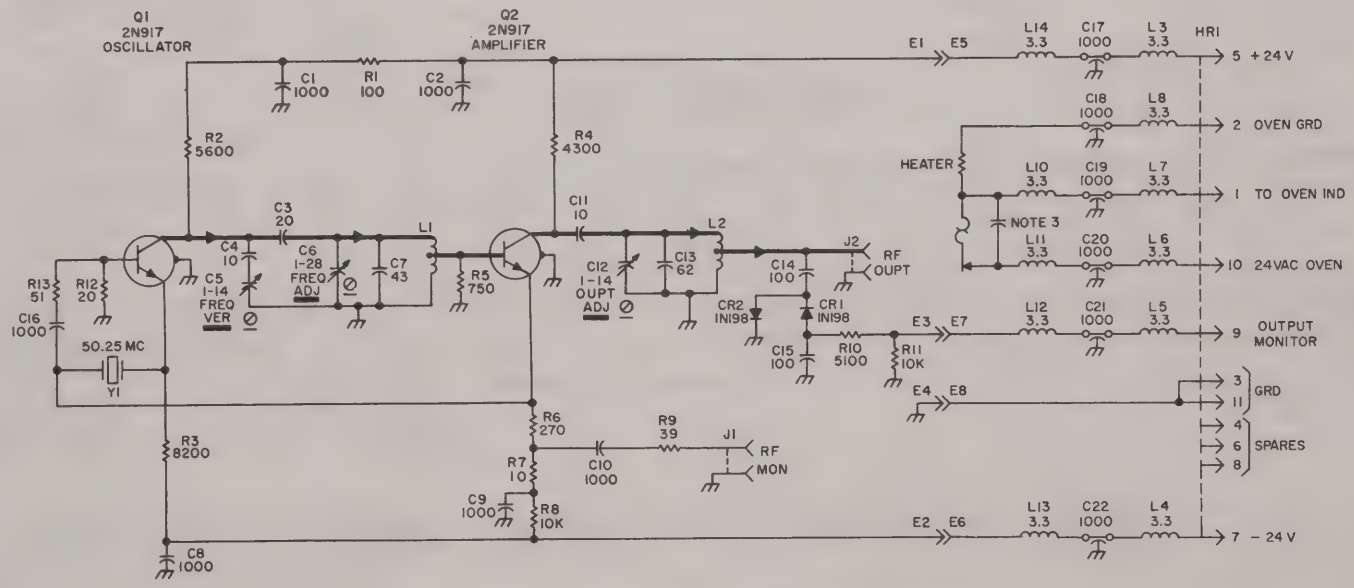
NOTES:
1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. PREFIX THE DESIGNATION WITH UNIT NUMBER OR ASSEMBLY DESIGNATION OR BOTH. (6A1A1)
2. UNLESS OTHERWISE INDICATED
   ALL RESISTANCE VALUES ARE IN OHMS 1/2 WATT.
   ALL CAPACITANCE VALUES ARE IN UF
3. ITEMS IN PARENTHESIS ARE FOR REFERENCE ONLY AND ARE NOT NECESSARILY STENCILED.
4. ALL VOLTAGE AND RESISTANCE MEASUREMENTS ARE NOMINAL AND ARE TAKEN BETWEEN SPECIFIED PIN AND GROUND WITH RCA VTVM TYPE WV98A OR EQUIVALENT.
5. ALL RESISTANCE MEASUREMENTS ARE TAKEN WITH ALL EXTERNAL CONNECTIONS REMOVED.
6. DC RESISTANCE OF TRANSFORMER LESS THAN ONE OHM NOT SHOWN.

S2 METER SELECTOR SWITCH		
POS.	CONTACTS	FUNCTION
1	1 AND 8	24V(OVENS)
2	2 AND 9	+24V
3	3 AND 10	-24V
4	4 AND 11	+12V
5	5 AND 12	-12V

FIGURE 5—52. POWER SUPPLY—BLOWER, SCHEMATIC DIAGRAM.

22731-02

NOTES:
1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. PREFIX THE DESIGNATION WITH UNIT NUMBER OR ASSEMBLY DESIGNATION OR BOTH.
2. UNLESS OTHERWISE INDICATED:
   ALL RESISTANCE VALUES ARE IN OHMS, 1/4 WATT,
   ALL CAPACITANCE VALUES ARE IN UUF,
   ALL INDUCTANCE VALUES ARE IN UH.
3. 2000 UUF CAPACITOR IS PART OF OVEN.
4. ALL VOLTAGE AND RESISTANCE MEASUREMENTS ARE NOMINAL AND ARE TAKEN BETWEEN SPECIFIED PIN AND GROUND WITH RCA VTVM TYPE WV98A OR EQUIVALENT.
5. ALL RESISTANCE MEASUREMENTS ARE TAKEN WITH ALL EXTERNAL CONNECTIONS REMOVED.
6. DC RESISTANCE OF COILS LESS THAN ONE OHM NOT SHOWN.



		EMIT	BASE	COLL
Q1	V	-8	0	7.2
	R	∞	18	∞
Q2	V	-6.4	0	14.5
	R	∞		∞

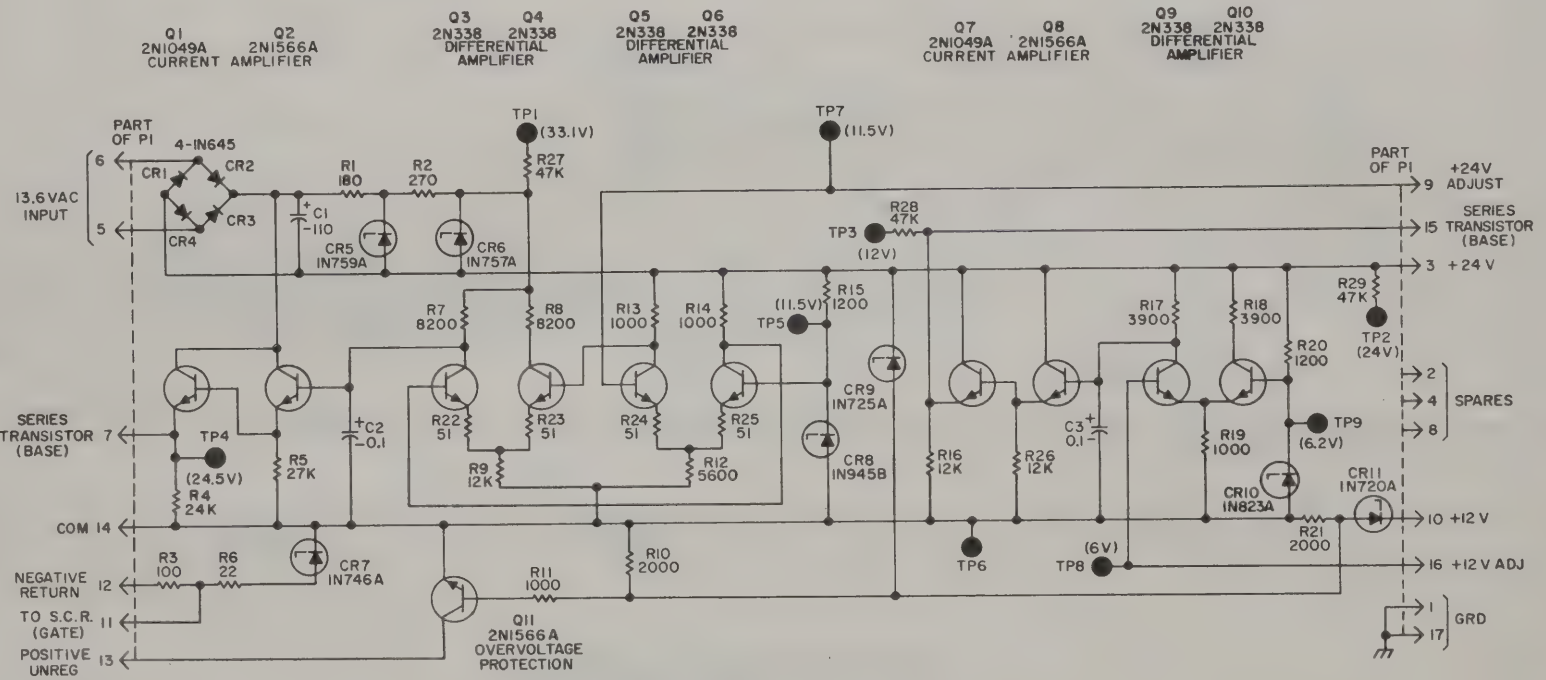
MEASURED ON R X 1 RANGE

23480-02

FIGURE 5—53. REFERENCE OSCILLATOR, TYPE 1130, SCHEMATIC DIAGRAM.

NOTES:

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. PREFIX THE DESIGNATION WITH UNIT NUMBER OR ASSEMBLY DESIGNATION OR BOTH.
2. UNLESS OTHERWISE INDICATED ALL RESISTANCE VALUES ARE IN OHMS, 1/2 WATT, ALL CAPACITANCE VALUES ARE IN UF,
3. Q1 AND Q7 REQUIRE HEAT SINKS.
4. ALL VOLTAGE AND RESISTANCE MEASURMENTS ARE NOMINAL AND ARE TAKEN BETWEEN SPECIFIED PIN AND TP6 WITH RCA VTVM TYPE WV98A OR EQUIVALENT.
5. ALL RESISTANCE MEASUREMENTS ARE TAKEN WITH ALL EXTERNAL CONNECTIONS REMOVED.



		EMIT	BASE	COLL
Q1	V	24.5	25	42
	R	28K	18K	38K
Q2	V	25	25.5	42
	R	18K	38K	38K
Q3	V	22	22.5	25.5
	R	13K	8K	38K
Q4	V	22	22.5	24
	R	13K	8.2K	50K
Q5	V	11	11.5	22.5
	R	6.5K	18K	8.5K
Q6	V	11	11.5	22.5
	R	6.5K	8.3K	8K

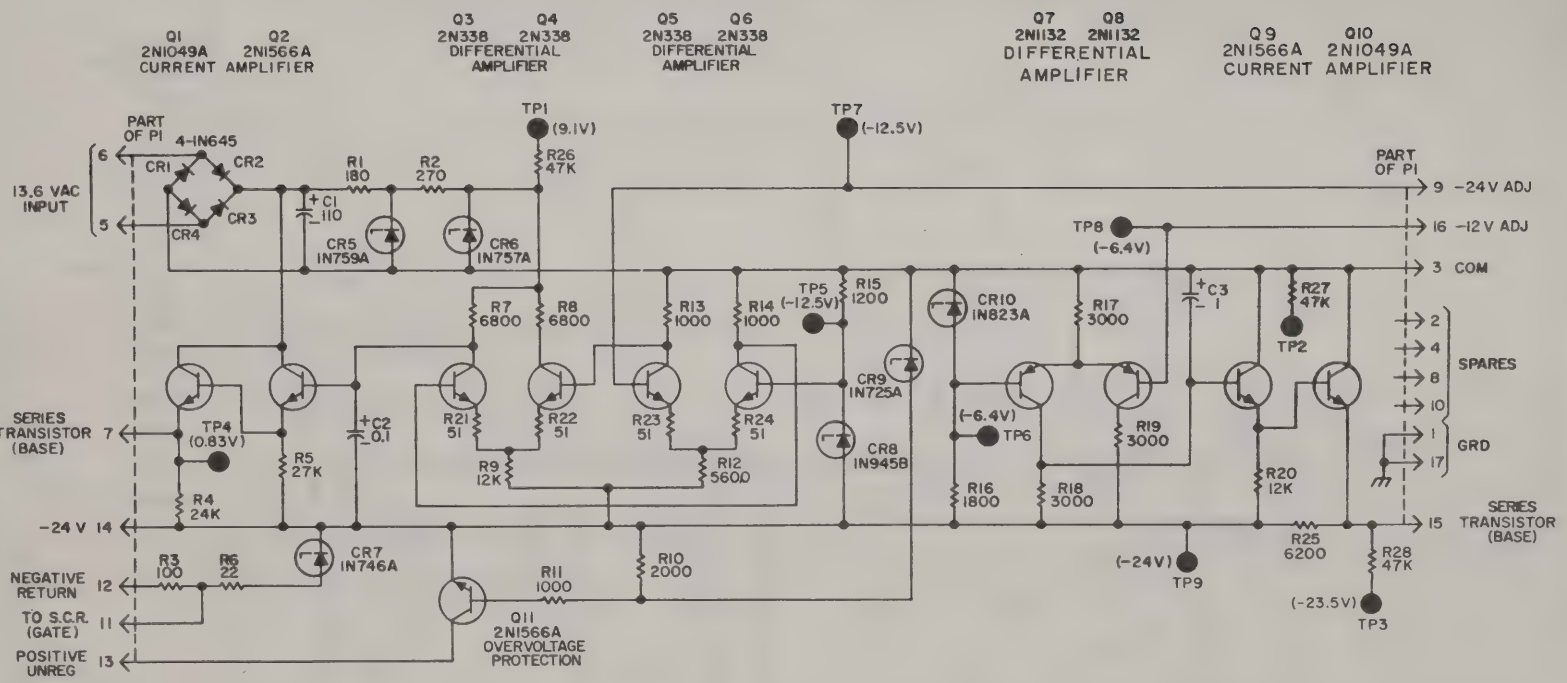
		EMIT	BASE	COLL
Q7	V	12	12.5	23.5
	R	13K	9.3K	6.8K
Q8	V	12.5	13	23.5
	R	9.4K	15K	6.8K
Q9	V	5.4	6	14.2
	R	1K	9.9K	15K
Q10	V	5.4	6.2	5.8
	R	1.5K	7K	10.5K
Q11	V	0	0	35
	R		2.1K	∞

FIGURE 5—54. REGULATOR (+12/+24 VOLTS), SCHEMATIC DIAGRAM.

23290-02

NOTES:

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. PREFIX THE DESIGNATION WITH UNIT NUMBER OR ASSEMBLY DESIGNATION OR BOTH.
2. UNLESS OTHERWISE INDICATED ALL RESISTANCE VALUES ARE IN OHMS, 1/2 WATT, ALL CAPACITANCE VALUES ARE IN UF.
3. Q1 AND Q10 REQUIRE HEAT SINKS.
4. ALL VOLTAGE AND RESISTANCE MEASUREMENTS ARE NOMINAL AND ARE TAKEN BETWEEN SPECIFIED PIN AND P1-3 WITH RCA VTVM TYPE WV98A OR EQUIVALENT.
5. ALL RESISTANCE MEASUREMENTS ARE TAKEN WITH ALL EXTERNAL CONNECTIONS REMOVED.



		EMIT	BASE	COLL			EMIT	BASE	COLL
Q1	V	0.83	1.5	17	Q7	V	-5.7	-6.4	-22.5
	R	40K(b)	34K(b)	80K(b)		R	2.9K(b)	9.4K(b)	5.4K(b)
Q2	V	1.5	2	17	Q8	V	-5.7	-6.4	-20.5
	R	34K(b)	80K(b)	80K(b)		R	2.9K(b)	∞	11.3K(b)
Q3	V	-1.6	-1	2	Q9	V	-23	-22.5	0
	R	23K(b)	950(a)	80K(b)		R	4K(b)	5.4K(b)	
Q4	V	-1.6	-1	0.4	Q10	V	-23.5	-23	0
	R	23K(b)	970(a)	100K(b)		R	14.9K(b)	4K(b)	
Q5	V	-13.2	-12.5	-1	Q11	V	-24.5	-24.5	11.3
	R	14.7K(b)	8.9K(b)	970(a)		R	6.6K(b)	7.3K(b)	∞
Q6	V	-13.2	-12.5	-1.04					
	R	14.8K(b)	980(a)	950(a)					

a - MEASURED ON R X 100 RANGE
b - MEASURED ON R X 1000 RANGE

FIGURE 5-55. REGULATOR (-12/-24 VOLTS), SCHEMATIC DIAGRAM.

23300-02

NOTES:
1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. PREFIX THE DESIGNATION WITH UNIT NUMBER OR ASSEMBLY DESIGNATION OR BOTH.
2. UNLESS OTHERWISE INDICATED ALL RESISTANCE VALUES ARE IN OHMS, ALL CAPACITANCE VALUES ARE IN UUF, ALL INDUCTANCE VALUES ARE IN UH.
3. ITEMS IN PARENTHESIS ARE FOR REFERENCE ONLY AND ARE NECESSARILY STENCILED.
4. DC RESISTANCE OF COILS LESS THAN ONE OHM NOT SHOWN.

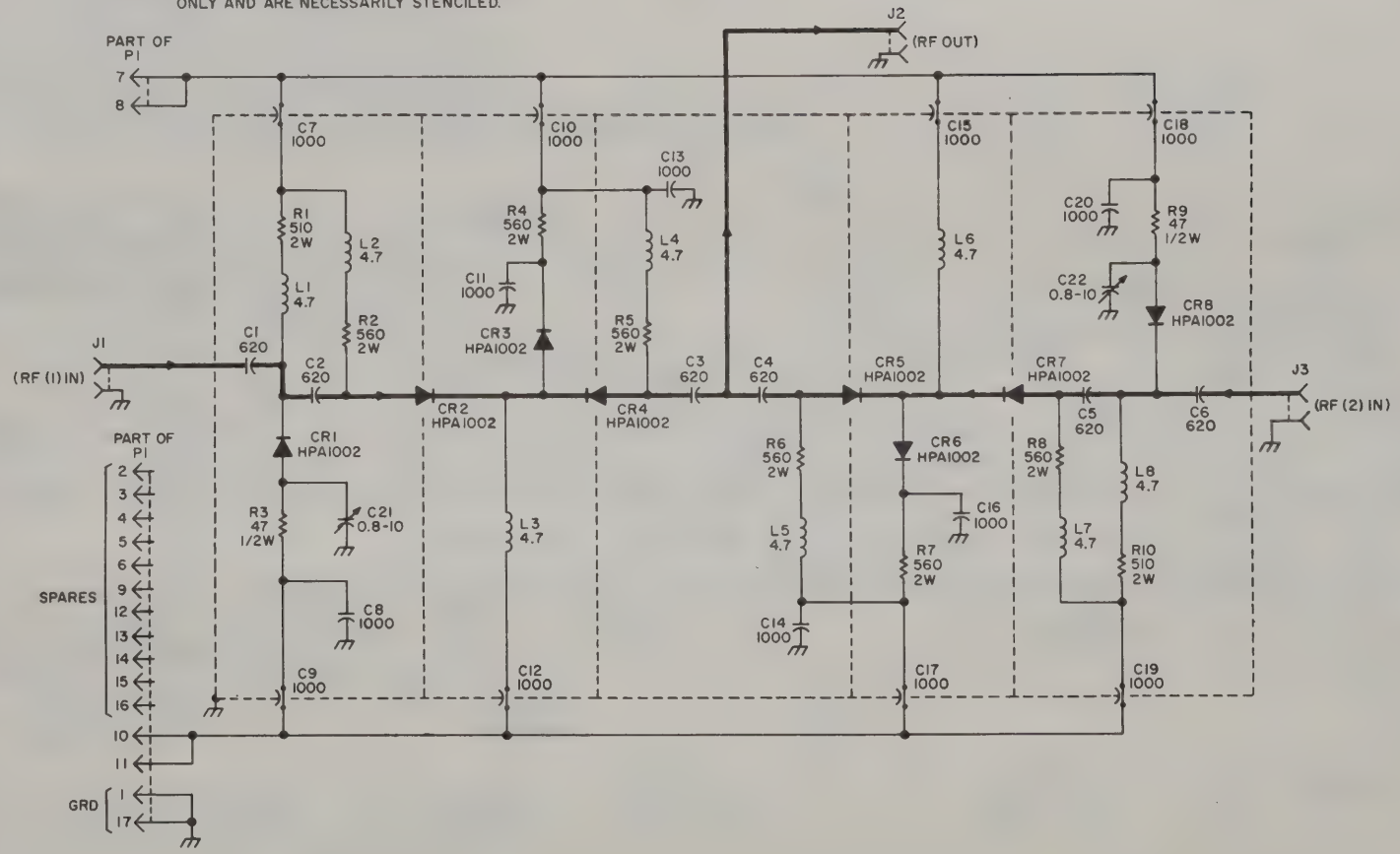


FIGURE 5—56. SOLID—STATE SWITCH, TYPE 1130, SCHEMATIC DIAGRAM.

23130-02

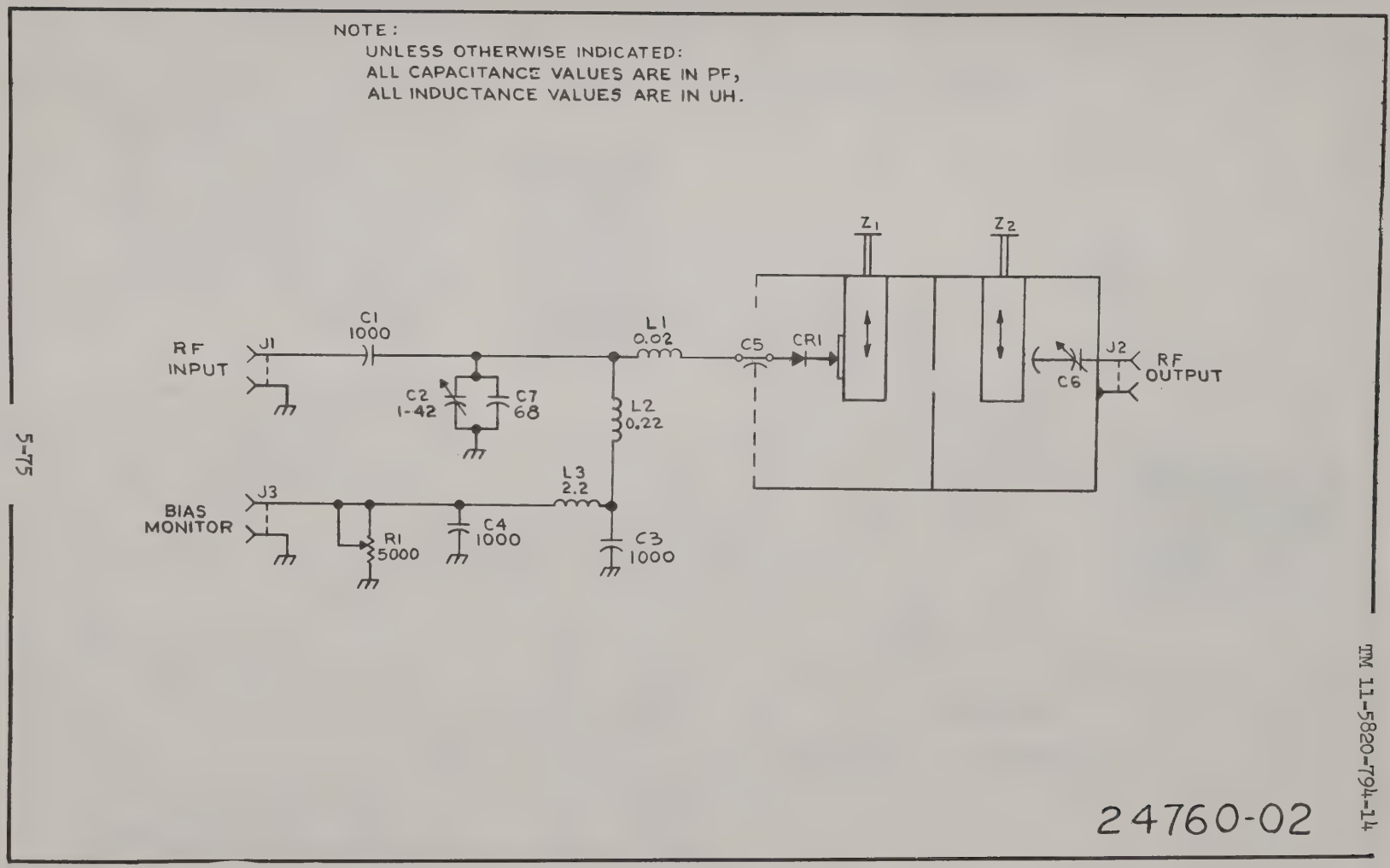
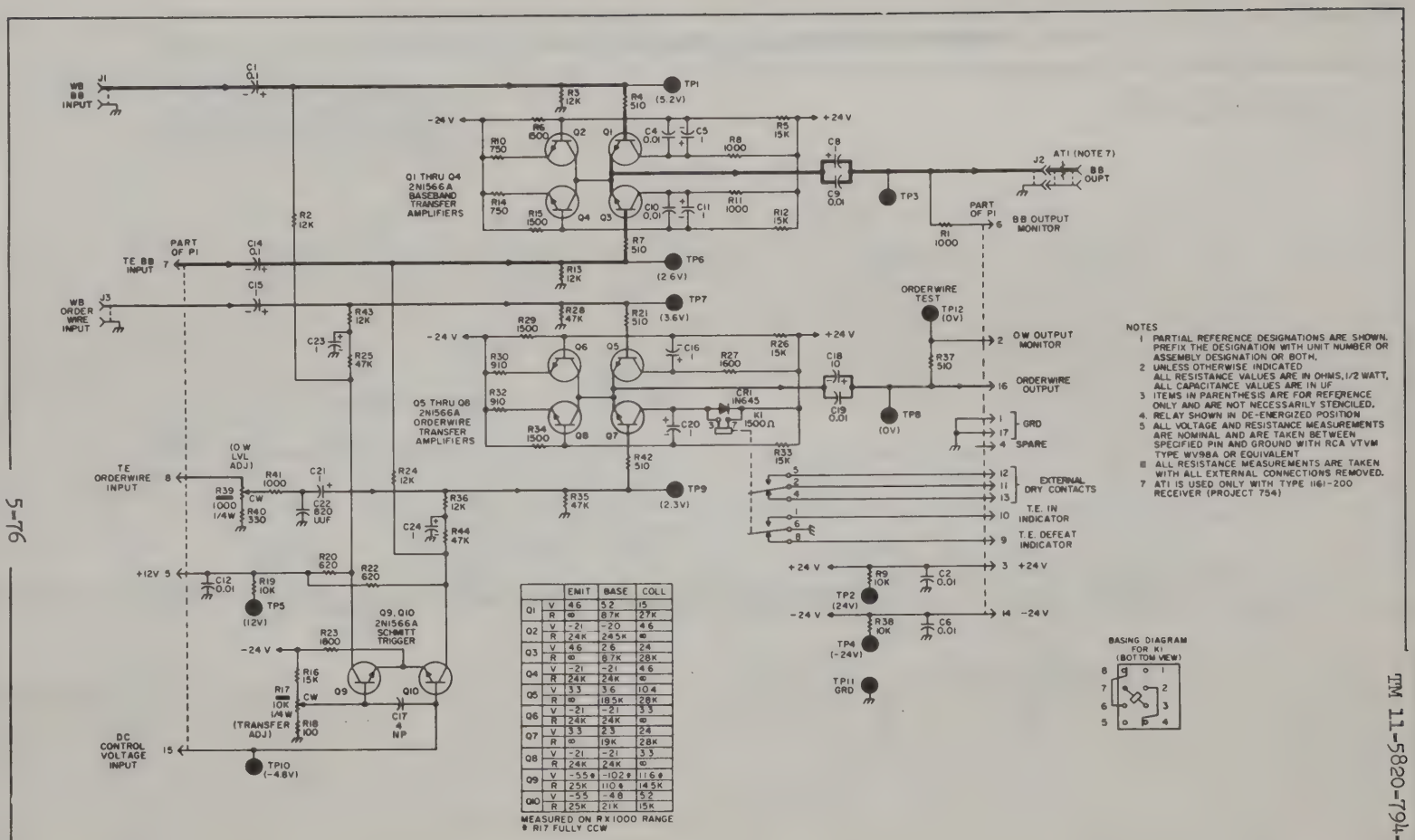


FIGURE 5—57. SRD MULTIPLIER, SCHEMATIC DIAGRAM.



		EMIT	BASE	COLL
Q1	V	46	52	15
	R	∞	87K	27K
Q2	V	-21	-20	46
	R	24K	245K	∞
Q3	V	46	26	24
	R	∞	87K	28K
Q4	V	-21	-21	46
	R	24K	24K	∞
Q5	V	33	36	104
	R	∞	185K	28K
Q6	V	-21	-21	33
	R	24K	24K	∞
Q7	V	33	23	24
	R	∞	19K	28K
Q8	V	-21	-21	33
	R	24K	24K	∞
Q9	V	-55*	-102*	116*
	R	25K	110*	14.5K
Q10	V	-55	-48	52
	R	25K	21K	15K

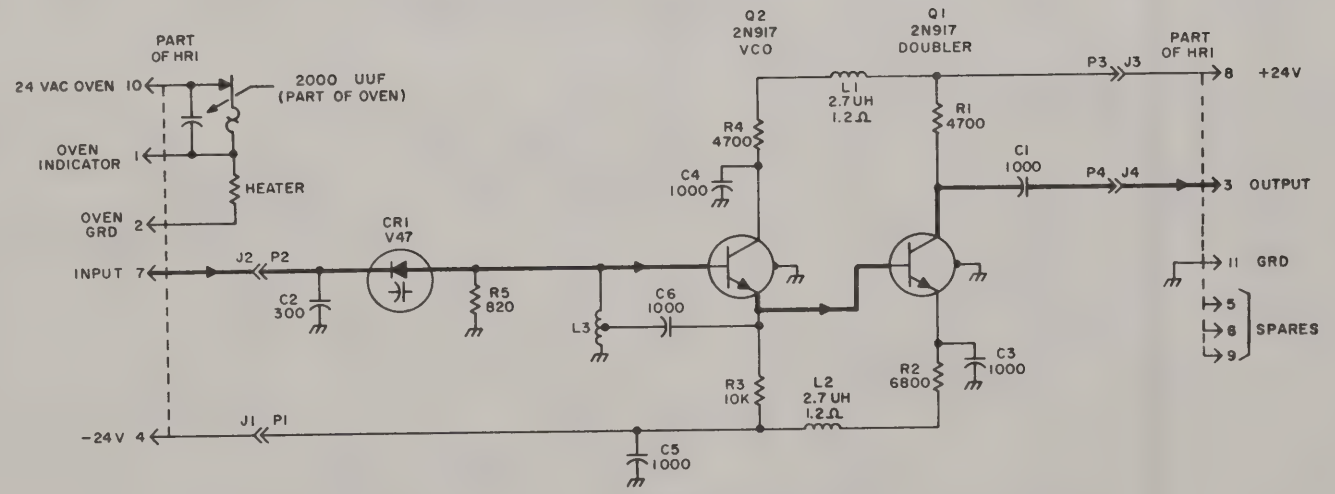
MEASURED ON RX1000 RANGE
* R17 FULLY CCW

FIGURE 5-58. TRANSFER, TYPE 1130, SCHEMATIC DIAGRAM.

23500-02

NOTES:

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. PREFIX THE DESIGNATION WITH UNIT NUMBER OR ASSEMBLY DESIGNATION OR BOTH.
2. UNLESS OTHERWISE INDICATED:
   ALL RESISTANCE VALUES ARE IN OHMS, 1/4 WATT,
   ALL CAPACITANCE VALUES ARE IN UUF.
3. ALL VOLTAGE AND RESISTANCE MEASUREMENTS ARE NOMINAL AND ARE TAKEN BETWEEN SPECIFIED PIN AND GROUND WITH RCA VTVM TYPE WV98A OR EQUIVALENT.
4. ALL RESISTANCE MEASUREMENTS TAKEN WITH ALL EXTERNAL CONNECTIONS REMOVED.
5. DC RESISTANCE OF COILS LESS THAN ONE OHM NOT SHOWN.



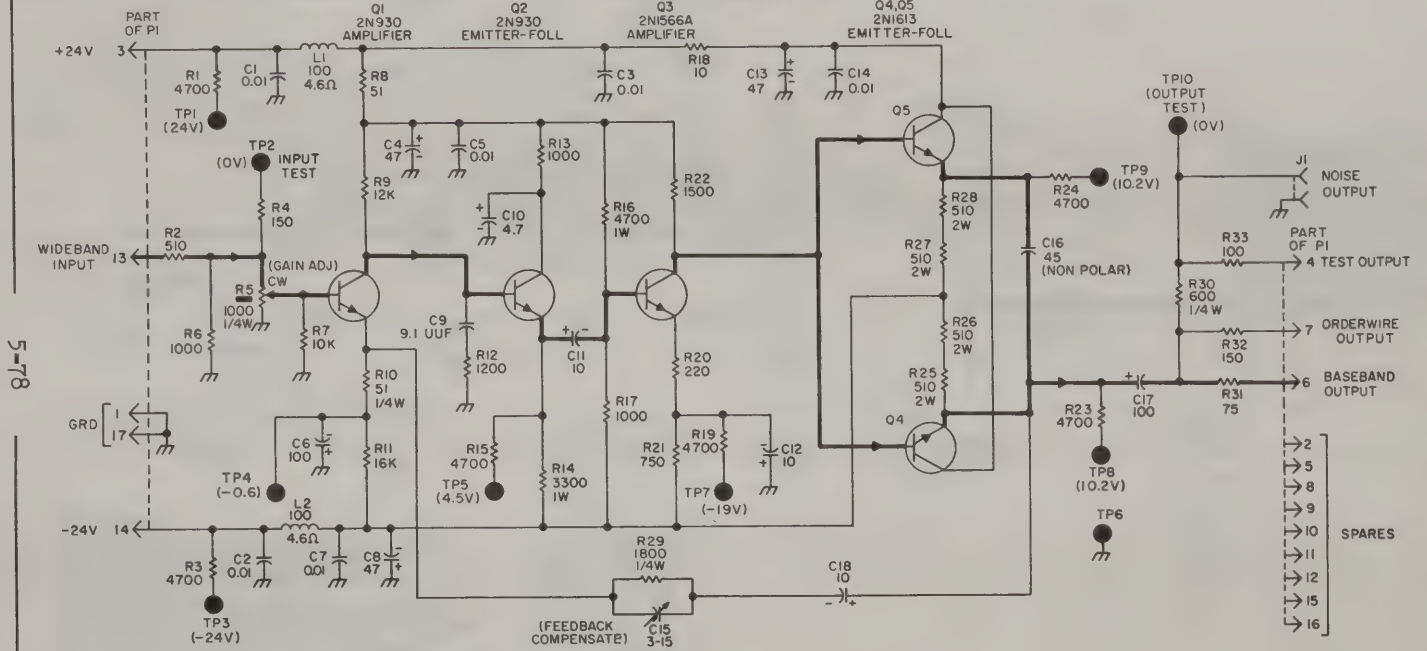
		EMITTER	BASE	COLL
Q1	V	-1.1	-0.55	8.3
	R	∞	∞	∞
Q2	V	-0.55	0	14
	R	∞		∞

23440-02

FIGURE 5—59. VCO AND DOUBLER, TYPE 1130, SCHEMATIC DIAGRAM.

NOTES:

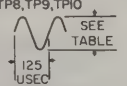
1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN PREFIX THE DESIGNATION WITH UNIT NUMBER OR ASSEMBLY DESIGNATION OR BOTH.
2. UNLESS OTHERWISE INDICATED:
   ALL RESISTANCE VALUES ARE IN OHMS, 1/2 W,
   ALL CAPACITANCE VALUES ARE IN UF,
   ALL INDUCTANCE VALUES ARE IN UH.
3. Q3, Q4 & Q5 REQUIRE HEAT SINKS.
4. ITEMS IN PARENTHESIS ARE FOR REFERENCE ONLY AND ARE NOT NECESSARILY STENCILED.
5. ALL VOLTAGE AND RESISTANCE MEASUREMENTS ARE NOMINAL AND ARE TAKEN BETWEEN SPECIFIED PIN AND GROUND WITH RCA VTVM TYPE WV98A OR EQUIVALENT.
6. ALL RESISTANCE MEASUREMENTS TAKEN WITH ALL EXTERNAL CONNECTIONS REMOVED.
7. WAVESHAPES TAKEN:
   a.) WITH HP130C SCOPE & HP200CD OSC.
   b.) ARE BENCH MEASUREMENTS WITH R5 ADJUSTED FOR 16 MVRMS OUTPUT FOR 1MVRMS INPUT AT 8KHZ AS MEASURED AT TP2.



		EMIT	BASE	COLL
Q1	V	-0.6	0	5.2
	R	50K	400‡	75K
Q2	V	4.5	5.1	14
	R	37K	75K	45K
Q3	V	-17	-16	11
	R	32K	∞	48K
Q4	V	10.2	11	23
	R	32K	48K	43K
Q5	V	10.2	11	23
	R	32K	48K	43K

MEASURED ON RX1000 RANGE
‡ R5 FULLY CW

WAVESHAPE FOR TP2, TP5 TP8, TP9, TP10



TP2	2.8 MV
TP5	7.1 MV
TP8 TP9 TP10	45 MV

FIGURE 5—60. WIDEBAND AMPLIFIER, TYPE 1130, SCHEMATIC DIAGRAM.

23430-02

APPENDIX A

REFERENCES

DA Pam 310-4	Index of Technical Manuals, Technical Bulletins, Supply Manuals, (types 7,8, and 9), Supply Bulletins, and Lubrication Orders.
DA Pam 310-7	U. S. Army Equipment Index of Modification Work Orders.
SB 38-100	Preservation, Packaging and Packing Materials, Supplies, and Equipment used by the Army.
TB SIG 355-1	Depot Inspection Standard for Repaired Signal Equipment.
TB SIG 355-2	Depot Inspection Standard for Refinishing Repaired Signal Equipment.
TB SIG 355-3	Depot Inspection Standard for Moisture and Fungus Resistant Treatment.
TB 746-10	Field Instructions for Painting and Preserving Electronics Command Equipment.
TM 38-750	The Army Maintenance Management Systems (TAMMS).

APPENDIX B

MAINTENANCE ALLOCATION

Section I. INTRODUCTION

B–1. General

This appendix provides a summary of the maintenance operations covered in the equipment literature for

It authorizes categories of maintenance for specific maintenance functions on repairable items and components and the tools and equipment required to perform each function. This appendix may be used as an aid in planning maintenance operations.

B–2. Maintenance Functions

Maintenance functions will be limited to and defined as follows:

a. INSPECT. To determine serviceability of an item by comparing its physical, mechanical, and electrical characteristics with established standards.

b. TEST. To verify serviceability and to detect incipient electrical or mechanical failure by use of special equipment such as gages, meters, etc. This is accomplished with external test equipment and does not include operation of the equipment and operator type tests using internal meters or indicating devices.

c. SERVICE. To clean, to preserve, to charge, and to add fuel, lubricants, cooling agents, and air. If it is desired that elements, such as painting and lubricating, be defined separately, they may be so listed.

d. ADJUST. To rectify to the extent necessary to bring into proper operating range.

e. ALIGN. To adjust two or more components or assemblies of an electrical or mechanical system so that their functions are properly synchronized. This does not include setting the frequency control knob of radio receivers or transmitters to the desired frequency.

f. CALIBRATE. To determine the corrections to be made in the readings of instruments or test equipment used in precise measurement. Consists of the comparison of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared with the certified standard.

g. INSTALL. To set up for use in an operational environment such as an encampment, site, or vehicle.

h. REPLACE. To replace unserviceable items with serviceable like items.

i. REPAIR. To restore an item to serviceable condition through correction of a specific failure or unserviceable condition. This function includes, but is not limited to welding, grinding, riveting, straightening, and replacement of parts other than the trial and error replacement of running spare type items such as fuses, lamps, or election tubes.

j. OVERHAUL. Normally, the highest degree of maintenance performed by the Army in order to minimize time work in process is consistent with quality and economy of operation. It consists of that maintenance necessary to restore an item to completely serviceable condition as prescribed by maintenance standards in technical publications for each item of equipment. Overhaul normally does not return an item to like new, zero mileage, or zero hour condition.

k. REBUILD. The highest degree of materiel maintenance. It consists of restoring equipment as nearly as possible to new condition in accordance with original manufacturing standards. Rebuild is performed only when required by operational considerations or other paramount factors and then only at the depot maintenance category. Rebuild reduces to zero the hours or miles the equipment, or component thereof, has been in use.

l. SYMBOLS. The uppercase letter placed in

the appropriate column indicates the lowest level at which that particular maintenance function is to be performed.

B-3. Explanation of Format

a. Column 1, group number. Column 1 lists group numbers, the purpose of which is to identify components, assemblies, subassemblies and modules with the next higher assembly.

b. Column 2, functional group. Column 2 lists the noun names of components, assemblies, subassemblies and modules on which maintenance is authorized.

c. Column 3, maintenance functions. Column 3 lists the maintenance category at which performance of the specific maintenance function is authorized. Authorization to perform a function at any category also includes authorization to perform that function at higher categories. The codes used represent the various maintenance categories as follows:

Code	*Maintenance Category*
C	Operator/Crew
O	Organizational Maintenance
F	Direct Support Maintenance
H	General Support Maintenance
D	Depot Maintenance

d. Column 4, tools and test equipment. Column 4 specifies, by code, those tools and test equipment required to perform the designated function. The numbers appearing in this column refer to specific tools and test equipment which are identified in table I.

e. Column 5, Remarks. Self-explanatory.

B-4. Explanation of Format of Table I, Tool and Test Equipment Requirements

The columns in Table I, Tool and Test Equipment Requirements are as follows:

a. Tools and Equipment. The numbers in this column coincide with the numbers used in the tools and equipment column of the Maintenance Allocation Chart. The numbers indicate the applicable tool for the maintenance function.

b. Maintenance Category. The codes in this column indicate the maintenance category normally allocated the facility.

c. Nomenclature. This column lists tools, test, and maintenance equipment required to perform the maintenance functions.

d. Federal Stock Number. This column lists the Federal stock number of the specific tool or test equipment.

e. Tool Number. Not used.

SECTION II - MAINTENANCE ALLOCATION CHART (TYPE 1130)

MAINTENANCE ALLOCATION CHART

GROUP NUMBER	COMPONENT ASSEMBLY NOMENCLATURE	MAINTENANCE FUNCTIONS											TOOLS AND EQUIPMENT	REMARKS
		INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL	REBUILD		
1	RECEIVER (REL 1130)	O												Visual
			F										1, 3, 5, 7, 12 thru 14, 16, 17, 22, 23, 25, 26, 31 thru 35, 41, 44, 50, 51	
					F								1, 3, 5, 7, 12 thru 14, 16, 17, 22, 23, 25, 26, 31 thru 36, 41, 44, 51	
										O			36	Replace lamps, knobs, and fuses
										F			1, 3, 5, 7, 12 thru 14, 16, 17, 22, 23, 25, 26, 31 thru 36, 41,44,50,51	Restore to serviceable condition
1A	POWER SUPPLY (REL 22731)	O												Visual
			H										40, 43	
					H								40, 43	
										O			36	Replace lamps, knobs and fuses
										F			36, 37, 43	Replace defective parts and modules
1A1	COMPONENT ASSEMBLY (REL 400248)	F												Visual
			F										43	
									F				36, 37	
										F			36, 37, 43	

SECTION II - MAINTENANCE ALLOCATION CHART (TYPE 1130)

MAINTENANCE ALLOCATION CHART

GROUP NUMBER	COMPONENT ASSEMBLY NOMENCLATURE	MAINTENANCE FUNCTIONS											TOOLS AND EQUIPMENT	REMARKS
		INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL	REBUILD		
1A2	VOLTAGE REGULATOR (REL 23290)	F												Visual
			H										38, 39, 40, 43	
									F				36, 37	
										H			36, 38, 39, 40, 43	
1A3	VOLTAGE REGULATOR (REL 23300)	F												Visual
			H										38, 39, 40, 43	
									F				36, 37	
										H			36, 38, 39, 40, 43	
1B	FREQUENCY CONVERTER (REL 22761)	F												Visual
			F										1, 3, 12 thru 14, 31, 35	
					F								1, 3, 6, 11 thru 14, 18 thru 20, 27 thru 29, 31, 35, 36	
										F			1, 3, 6, 11 thru 14, 18 thru 20, 27 thru 29, 31, 35, 36	Replace defective modules and piece parts
1B1	MIXER (REL 23320)	F												Visual
									H				36	
										D				Return to depot for further disposition

SECTION II - MAINTENANCE ALLOCATION CHART (TYPE 1130)

MAINTENANCE ALLOCATION CHART

GROUP NUMBER	COMPONENT ASSEMBLY NOMENCLATURE	MAINTENANCE FUNCTIONS											TOOLS AND EQUIPMENT	REMARKS
		INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL	REBUILD		
1B2	IF PREAMPLIFIER (REL 23330)	F	F										1, 3, 4, 7, 12, 13, 15, 18 thru 20, 31, 34	Visual
					F								1, 3, 4, 7, 12, 13, 15, 18 thru 20, 30, 31, 34, 36	
									F				36, 37	
										D				Return to depot for further disposition
1B3	SRD MULTIPLIER (REL 24760)	F												Visual
			H										1 thru 3, 5, 7, 8, 12 thru 14, 25, 26, 35, 38, 39, 42	
					H								1 thru 3, 5, 7, 8, 12 thru 14, 25, 26, 35, 36, 38, 39, 42	
									H				36	
										D				Return to depot for further disposition

SECTION II - MAINTENANCE ALLOCATION CHART (TYPE 1130)

MAINTENANCE ALLOCATION CHART

GROUP NUMBER	COMPONENT ASSEMBLY NOMENCLATURE	MAINTENANCE FUNCTIONS											TOOLS AND EQUIPMENT	REMARKS
		INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL	REBUILD		
1B4	LOW FREQUENCY AMPLIFIER (REL 22980)	F	H		H				F	H			1 thru 3, 8, 25, 26, 30, 38, 39, 42 1 thru 3, 8, 25, 26, 30, 36, 38, 39, 42 36, 37 1 thru 3, 8, 25, 26, 30, 36, 38, 39, 42	Visual
1B5	OSCILLATOR-DOUBLER (REL 24150)	F	H		H				F	H			1, 3, 12 thru 14, 38, 39, 42 1, 3, 12 thru 14, 36, 38, 39, 42 36, 37 1, 3, 12 thru 14, 36, 38, 39, 42	Visual
1B6	MONITOR CONTROL (REL 23351)	F	F						F	D			42 36, 37	Visual Return to depot for further disposition

SECTION II - MAINTENANCE ALLOCATION CHART (TYPE 1130)

MAINTENANCE ALLOCATION CHART

GROUP NUMBER	COMPONENT ASSEMBLY NOMENCLATURE	MAINTENANCE FUNCTIONS											TOOLS AND EQUIPMENT	REMARKS
		INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL	REBUILD		
1B7	PRESELECTOR (REL 23340)	F	H										12 thru 14, 18 thru 20, 25, 26, 31, 38, 39	Visual
					H								12 thru 14, 18 thru 20, 25, 26, 31, 36, 38,39	
									H				36	
										D				Return to depot for further disposition
1C	DEMODULATOR (REL 22771)	O	F										5, 7, 9, 10, 12, 13, 18 thru 20, 22, 23, 30, 42, 50, 51	Visual
						F							5, 7, 9, 10, 12, 13, 18 thru 20, 22, 23, 30, 36, 42, 50, 51	
											O			Replace lamps
											F		5, 7, 9, 10, 12, 13, 18 thru 20, 22, 23, 30, 36, 37, 42, 50, 51	Replace defective modules and piece parts

SECTION II - MAINTENANCE ALLOCATION CHART (TYPE 1130)

MAINTENANCE ALLOCATION CHART

GROUP NUMBER	COMPONENT ASSEMBLY NOMENCLATURE	MAINTENANCE FUNCTIONS											TOOLS AND EQUIPMENT	REMARKS
		INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL	REBUILD		
1C1	NOISE AMPLIFIER REFLEX AND RECORDER AMPLIFIER (REL 23590)	F												Visual
			H										21, 24, 38, 39, 42	
					H								21, 24, 36, 38, 39, 42	
									F				36, 37	
										H			21, 24, 36, 38, 39, 42	
1C2	ALARM AMPLIFIER (REL 23582)	F												Visual
			H										21, 24, 38, 39, 42	
									F				36, 37	
										H			21, 24, 36, 38, 39, 42	
1C3	BASEBAND AMPLIFIER (REL 23551)	F												Visual
			H										21, 24, 38, 39, 42	
					H								21, 24, 36, 38, 39, 42	
									F				36, 37	
										H			21, 24, 36, 38, 39, 42	

SECTION II - MAINTENANCE ALLOCATION CHART (TYPE 1130)

MAINTENANCE ALLOCATION CHART

GROUP NUMBER	COMPONENT ASSEMBLY NOMENCLATURE	MAINTENANCE FUNCTIONS											TOOLS AND EQUIPMENT	REMARKS
		INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL	REBUILD		
1C4	BUFFER AMPLIFIER (REL 23450)	F	H										1, 3, 18 thru 20, 30, 38, 39, 42	Visual
					H								1, 3, 18 thru 20, 30, 36, 38, 39, 42	
									F				36, 37	
										H			1, 3, 18 thru 20, 30, 36, 38, 39, 42	
1C5	DISTRIBUTION AMPLIFIER (REL 23402)	F	H										21, 24, 38, 39, 42	Visual
					H								21, 24, 36, 38, 39, 42	
									F				36, 37	
										H			21, 24, 36, 38, 39, 42	
1C6	AMPLIFIER, ERROR (REL 23180)	F	H										12, 13, 21, 24, 38, 39, 42	Visual
					H								12, 13, 21, 24, 36, 38, 39, 42	
									F				36, 37	
										H			12, 13, 21, 24, 36, 38, 39, 42	

MAINTENANCE ALLOCATION CHART

GROUP NUMBER	COMPONENT ASSEMBLY NOMENCLATURE	MAINTENANCE FUNCTIONS											TOOLS AND EQUIPMENT	REMARKS
		INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL	REBUILD		
1C7	IF AMPLIFIER (REL 23360)	F							H				36,37	Visual
										D				Return to depot for further disposition
1C8	IF AMPLIFIER (REL 23370)	F							F				36, 37	Visual
										D				Return to depot for further disposition
1C9	NOISE AMPLIFIER (REL 23520)	F							F				36, 37	Visual
										D				Return to depot for further disposition
1C10	NOISE AMPLIFIER (REL 23530)	F							F				36, 37	Visual
										D				Return to depot for further disposition
1C11	ORDERWIRE AMPLIFIER (REL 23571)	F												Visual
			H										21, 24, 38, 39, 42	
					F								21, 24, 36, 38, 39, 42	
									F				36, 37	
										H			21, 24, 36, 38, 39, 42	
1C12	PILOT AMPLIFIER (REL 23541)	F												Visual
			H										21, 24, 38, 39, 42	
					H								21, 24, 36, 38, 39, 42	
									F				36, 37	
										H			21, 24, 36, 38, 39, 42	

SECTION II - MAINTENANCE ALLOCATION CHART (TYPE 1130)

MAINTENANCE ALLOCATION CHART

GROUP NUMBER	COMPONENT ASSEMBLY NOMENCLATURE	MAINTENANCE FUNCTIONS											TOOLS AND EQUIPMENT	REMARKS
		INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL	REBUILD		
1C13	WIDEBAND AMPLIFIER (REL 23430)	F	H		H				F	H			21, 24, 38, 39, 42 21, 24, 36, 38, 39, 42 36, 37 21, 24, 36, 38, 39, 42	Visual Gain, frequency response, voltages Gain, feedback compensation
1C14	BANDWIDTH SELECTOR (REL 24081)	F	H		H				F	H			1, 3, 12, 13, 30, 38, 39, 42 1, 3, 12, 13, 30, 36, 38, 39, 42 36, 37 1, 3, 12, 13, 30, 36, 38, 39, 42	Visual
1C14.1	BANDWIDTH SELECTOR INPUT (REL 24011)	F	H		H				H	H			1, 3, 12, 13, 30, 38, 39, 42 1, 3, 12, 13, 30, 36, 38, 39, 42 36 1, 3, 12, 13, 30, 36, 38, 39, 42	Visual

SECTION II - MAINTENANCE ALLOCATION CHART (TYPE 1130)

MAINTENANCE ALLOCATION CHART

GROUP NUMBER	COMPONENT ASSEMBLY NOMENCLATURE	MAINTENANCE FUNCTIONS											TOOLS AND EQUIPMENT	REMARKS
		INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL	REBUILD		
1C14.2	BANDWIDTH SELECTOR OUTPUT (72 & 132 CHANNEL) (REL 24020)	F	H										1, 3, 12, 13, 30, 38, 39, 42	Visual
					H								1, 3, 12, 13, 30, 36, 38, 39, 42	
									H				36	
										H			1, 3, 12, 13, 30, 36, 38, 39, 42	
1C15	BANDWIDTH SELECTOR (REL 24080)	F	H										1, 3, 12, 13, 30, 38, 39, 42	Visual
					H								1, 3, 12, 13, 30, 36, 38, 39, 42	
									F				36, 37	
										H			1, 3, 12, 13, 30, 36, 38, 39, 42	
1C15.1	BANDWIDTH SELECTOR INPUT (72 CHANNEL) (REL 24010)	F	H										1, 3, 12, 13, 30, 38, 39, 42	Visual
					H								1, 3, 12, 13, 30, 36, 38, 39, 42	
									H				36	
										H			1, 3, 12, 13, 30, 36, 38, 39, 42	

MAINTENANCE ALLOCATION CHART

GROUP NUMBER	COMPONENT ASSEMBLY NOMENCLATURE	MAINTENANCE FUNCTIONS											TOOLS AND EQUIPMENT	REMARKS
		INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL	REBUILD		
1C16	CHANNEL CAPACITY SELECTOR (REL 23495)	F	H										21, 24, 38, 39, 42	Visual
					H								21, 24, 36, 38, 39, 42	
									F	H			36, 37 21, 24, 36, 38, 39, 42	
1C17	CHANNEL CAPACITY SELECTOR (REL 23494)	F	H										21, 24, 38, 39, 42	Visual
					H								21, 24, 36, 38, 39, 42	
									F	H			36, 37 21, 24, 36, 38, 39, 42	
1C18	COMBINER (REL 23510)	F	H										21, 24, 38, 39, 42	Visual
					H								21, 24, 36, 38, 39, 42	
									F	H			36, 37 21, 24, 36, 38, 39, 42	

SECTION II - MAINTENANCE ALLOCATION CHART (TYPE 1130)

MAINTENANCE ALLOCATION CHART

GROUP NUMBER	COMPONENT ASSEMBLY NOMENCLATURE	MAINTENANCE FUNCTIONS											TOOLS AND EQUIPMENT	REMARKS
		INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL	REBUILD		
1C19	COMPRESSOR-LIMITER (REL 23460)	F	H		H				F	H			1, 3, 18 thru 20, 30, 38, 39, 42, 46, 47, 49 1, 3, 18 thru 20, 30, 36, 38, 39, 42, 46, 47, 49 36, 37 1, 3, 18 thru 20, 30, 36, 38, 39, 42, 46, 47, 49	Visual
1C20	COMPRESSOR-LIMITER (REL 23380)	F	H		H				F	H			1, 3, 18 thru 20, 27 thru 30, 36, 38, 39, 42, 46, 47, 49 1, 3, 18 thru 20, 27 thru 30, 36, 38, 39, 42, 46, 47, 49 36, 37 1, 3, 18 thru 20, 27 thru 30, 36, 38, 39, 42, 46, 47, 49	Visual

SECTION II - MAINTENANCE ALLOCATION CHART (TYPE 1130)

MAINTENANCE ALLOCATION CHART

GROUP NUMBER	COMPONENT ASSEMBLY NOMENCLATURE	MAINTENANCE FUNCTIONS										TOOLS AND EQUIPMENT	REMARKS
		INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL	REBUILD	
1C21	CHOPPER-DEMODULATOR (REL 23150)	F											Visual
			F										12, 13, 15, 23
					F								12, 13, 15, 23, 36
									F				36, 37
										D			Return to depot for further disposition
1C22	DRIVER-DISCRIMINATOR (REL 23470)	F											Visual
			F										1, 3, 12 thru 15, 22, 23, 30, 42, 48
					F								1, 3, 12 thru 15, 22, 23, 30, 36, 42, 48
									F				36, 37
										D			Return to depot for further disposition
1C23	DRIVER-DISCRIMINATOR (REL 23391)	F											Visual
			H										12 thru 14, 18 thru 20, 27 thru 30, 38, 39, 42, 49
					H								12 thru 14, 18 thru 20, 27 thru 30, 36, 38, 39, 42, 49
									F				36, 37
										H			12 thru 14, 18 thru 20, 27 thru 30, 36, 38, 39, 42, 49

SECTION II - MAINTENANCE ALLOCATION CHART (TYPE 1130)

MAINTENANCE ALLOCATION CHART

GROUP NUMBER	COMPONENT ASSEMBLY NOMENCLATURE	MAINTENANCE FUNCTIONS											TOOLS AND EQUIPMENT	REMARKS
		INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL	REBUILD		
1C24	DRIVER-DISCRIMINATOR (REL 23390)	F												Visual
			H										12 thru 14, 18 thru 20, 27 thru 30, 38, 39, 42, 49	
					H								12 thru 14, 18 thru 20, 27 thru 30, 36, 38, 39, 42, 49	
									F				36, 37	
										H			12 thru 14, 18 thru 20, 27 thru 30, 36, 38, 39, 42, 49	
1C25	LIMITER-DISCRIMINATOR (REL 23420)	F												Visual
									F				36, 37	
										D				Return to depot for further disposition
1C26	NOISE AMPLIFIER AND DETECTOR (REL 23090)	F												Visual
			H										1	
					H								1, 36	
									F				36, 37	
										H			1, 36, 37	
1C27	MIXER (REL 23410)	F												Visual
									F				36, 37	
										D				Return to depot for further disposition
1C28	MONITOR CONTROL SECTION (REL 23601)	F												Visual
			H										43	
									F				36, 37	
										O			36	Replace knob
										H			36, 43	

MAINTENANCE ALLOCATION CHART

GROUP NUMBER	COMPONENT ASSEMBLY NOMENCLATURE	MAINTENANCE FUNCTIONS										TOOLS AND EQUIPMENT	REMARKS
		INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL	REBUILD	
1C29	REFERENCE OSCILLATOR (REL 23480)	F											Visual
			D										12 thru 14, 38, 39, 42
					D								12 thru 14, 36, 38, 39, 42
									F				36, 37
										D			Return to depot for further inspection
1C30	SWITCH, SOLID STATE (REL 23130)	F											Visual
			H										1, 3, 18 thru 20, 30, 38, 39, 42, 44, 45, 47
					H								1, 3, 18 thru 20, 30, 36, 38, 39, 42, 44, 45, 47
									F				36, 37
										H			1, 3, 18 thru 20, 30, 36, 38, 39, 42, 44, 45, 47
1C31	TRANSFER (REL 23500)	F											Visual
			H										21, 24, 38, 39, 42
					H								21, 24, 36, 38, 39, 42
									F				36, 37
										H			21, 24, 36, 38, 39, 42

SECTION II - MAINTENANCE ALLOCATION CHART (TYPE 1130)

MAINTENANCE ALLOCATION CHART

GROUP NUMBER	COMPONENT ASSEMBLY NOMENCLATURE	MAINTENANCE FUNCTIONS											TOOLS AND EQUIPMENT	REMARKS
		INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL	REBUILD		
1C32	VCO & DOUBLER (REL 23440)	F												Visual
			D										1, 3, 12, 13, 38, 39, 42	
					D								1, 3, 12, 13, 36, 38, 39, 42	
									F				36, 37	
										D				Return to depot for further disposition
1C33	PHASE EQUALIZER (REL PF 1442)	F												Visual
									F				36, 37	
										D				Return to depot for further disposition
1C34	PHASE EQUALIZER (REL PF 1443)	F												Visual
									F				36, 37	
										D				Return to depot for further disposition
1C35	BANDPASS FILTER (REL FL 5246)	F												Visual
			F										1 thru 3, 12 thru 15	
									F				36, 37	
										D				Return to depot for further disposition
1C36	HIGH PASS FILTER (REL PF 1432)	F												Visual
			F										1 thru 3, 12 thru 15	
									F				36, 37	
										D				Return to depot for further disposition
1C37	HIGH PASS FILTER (REL PF 1433)	F												Visual
			F										1 thru 3, 12 thru 15	
									F				36, 37	
										D				Return to depot for further disposition

MAINTENANCE ALLOCATION CHART

GROUP NUMBER	COMPONENT ASSEMBLY NOMENCLATURE	MAINTENANCE FUNCTIONS											TOOLS AND EQUIPMENT	REMARKS
		INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL	REBUILD		
1C38	IF FILTER (REL PF 1425)	F												Visual
			F										1 thru 3, 12 thru 15 36, 37	
									F					
										D				Return to depot for further disposition
1C39	IF FILTER (REL PF 1394)	F												Visual
			F										1 thru 3, 12 thru 15 36, 37	
									F					
										D				Return to depot for further disposition
1C40	LOW PASS FILTER (REL PF 1464)	F												Visual
			F										1 thru 3, 12 thru 15 36, 37	
									F					
										D				Return to depot for further disposition
1C41	PILOT FILTER (REL PF 1455)	F												Visual
			F										1 thru 3, 12 thru 15 36, 37	
									F					
										D				Return to depot for further disposition
1C42	RUMBLE FILTER (REL PF 1260)	F												Visual
			F										1 thru 3, 12 thru 15 36, 37	
									F					
										D				Return to depot for further disposition
1C43	SHAPING FILTER (REL PF 1448)	F												Visual
			F										1 thru 3, 12 thru 15 36, 37	
									F					
										D				Return to depot for further disposition

MAINTENANCE ALLOCATION CHART

GROUP NUMBER	COMPONENT ASSEMBLY NOMENCLATURE	MAINTENANCE FUNCTIONS											TOOLS AND EQUIPMENT	REMARKS
		INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL	REBUILD		
1C44	SHAPING FILTER (REL PF 1449)	F	F						F	D			1 thru 3, 12 thru 15 36, 37	Visual Return to depot for further disposition

TABLE I - TOOL AND TEST EQUIPMENT REQUIREMENTS (TYPE 1130)

TOOL AND TEST EQUIPMENT REQUIREMENTS

TOOLS AND EQUIPMENT	MAINTENANCE CATEGORY	NOMENCLATURE		FEDERAL STOCK NUMBER	TOOL NUMBER
		Recommended in Manual	Available on Site		
1	F, H	RF Voltmeter, Boonton Type 91CA	RF Voltmeter, Boonton Electronics 91DA		
2	F, H	Unterminated BNC Adapter, Boonton Electronics 91-6C	Unterminated BNC Adapter, Boonton Electronics 91-6C		
3	F, H	50 ohm BNC Adapter, Boonton Electronics 91-8B	50 ohm BNC Adapter, Boonton Electronics 91-8B		
4	F	6 db Attenuator, AB-06N-Microlab	6 db Attenuator, Microlab AB-06N		
5	F, H	10 db RF Attenuator, Microlab AB-10	10 db Attenuator, Microlab AB-10N		
6	F	12 db RF Attenuator, Microlab AB-12			
7	F, H	20 db Attenuator, Microlab AB-20	20 db Attenuator, Microlab AB-20N		
8	F, H	30 db Attenuator, AB-30N	30 db Attenuator, Microwave AB-30N		
9	F	Delay & Linearity Test Receiver, RCA CS-81	Delay & Linearity Test Receiver, RCA CS-81		
10	F	Delay & Linearity Test Transmitter, RCA CS-80	Delay & Linearity Test Transmitter, RCA CS-80		
11	F	Detector, Alfred 1001	Detector, Alfred Electronics 1001		
12	F, H, D	Frequency Counter, Berkeley 7170 with frequency converters 7571, 7572, 7573	Electronic Counter, Hewlett Packard 5245L		
13	F, H, D		Frequency Converter, Hewlett Packard 5253B		
14	F, H, D		Frequency Converter, Hewlett Packard 5254A		
15	F	*Modem, Radio Engineering Labs 22871	*Modem, Radio Engineering Labs 22871		
16	F	*Noise Analyzer, Radio Engineering Labs 22821	*Noise Analyzer, Radio Engineering Labs 22821		
17	F	*Noise Generator, Radio Engineering Labs 22831	*Noise Generator, Radio Engineering Labs 22831		
		*Part of Performance Monitor TYPE 1095A			

TABLE I - TOOL AND TEST EQUIPMENT REQUIREMENTS (TYPE 1130)

TOOL AND TEST EQUIPMENT REQUIREMENTS

TOOLS AND EQUIPMENT	MAINTENANCE CATEGORY	NOMENCLATURE		FEDERAL STOCK NUMBER	TOOL NUMBER
		Recommended in Manual	Available on Site		
18	F, H	Oscilloscope, Hewlett Packard 130C	Oscilloscope, Tektronix 561A		
19	F, H		Dual Trace Amplifier, Tektronix 3A72		
20	F, H		Time Base Unit, Tektronix 2B67		
21	H	Test Oscillator, Hewlett Packard 651B-02	Test Oscillator, Hewlett Packard 651B-01		
22	F	*Test Oscillator, Radio Engineering Labs 22800	*Test Oscillator, Radio Engineering Labs 22800		
23	F	*AC VTVM, REL 22812	*AC VTVM, REL 22812		
24	H	AC VTVM, Hewlett Packard 403B-01	AC VTVM, Hewlett Packard 403B-01		
25	F, H	Power Meter, Hewlett Packard 431B	Power Meter, Hewlett Packard 431C		
26	F, H	Thermistor Mount, Hewlett Packard 478A	Thermistor Mount, Hewlett Packard 478A		
27	F, H	UHF Sweep Generator, Hewlett Packard H01-692B	UHF Sweep Generator, Hewlett Packard 8690A		
28	F, H		Hewlett Packard 8698A Plug-In		
29	F, H		Hewlett Packard 8692B Plug-In		
30	F, H	VHF Signal Generator, Hewlett Packard 608D	VHF Signal Generator, Hewlett Packard 608D		
31	F, H	UHF Signal Generator, Hewlett Packard 616B/S	UHF Signal Generator, Hewlett Packard 8614A		
32	F	VSWR Indicator, Hewlett Packard 415B	VSWR Indicator, Hewlett Packard 415E		
33	F	Slotted Line, Hewlett Packard 805A	Slotted Line, Hewlett Packard 805A		
34	F	50 ohm Resistive Termination, Microlab TA-5-MN	50 ohm Resistive Termination, Microlab TA-5-MN		

*Part of Performance Monitor TYPE 1095A

TABLE I - TOOL AND TEST EQUIPMENT REQUIREMENTS (TYPE 1130)

TOOL AND TEST EQUIPMENT REQUIREMENTS

TOOLS AND EQUIPMENT	MAINTENANCE CATEGORY	NOMENCLATURE		FEDERAL STOCK NUMBER	TOOL NUMBER
		Recommended in Manual	Available on Site		
35	F, H	Frequency Meter, Hewlett Packard 536A	Frequency Meter, Hewlett Packard 536A		
36	O, F, H, D		Tool Kit, Radio Technicians		
37	F	Module Extracting Tool (supplied with equipment)	Module Extracting Tool (supplied with equipment)		
38	H, D	Module Tester, Radio Engineering Labs 25280	Module Tester, Radio Engineering Labs 25280		
39	H, D	Adapter Kit, Radio Engineering Labs 27244	Adapter Kit, Radio Engineering Labs 27244		
40	H	Differential Voltmeter, Fluke 803B			
41	F	*Up Converter, Radio Engineering Labs 23942	*Up Converter, Radio Engineering Labs 23942		
42	F, H, D	AC/DC VTVM, Hewlett Packard 410B	AC/DC VTVM, Hewlett Packard 410B		
43	F, H	VOM, Simpson 260	VOM, Simpson 260-5RT		
44	H	VSWR Detector, Telonic TRB-2	VSWR Detector, Telonic TRB-2		
45	H	Termination TRM-1.-1.00F (Telonic)	Termination TRM-1.-1.00F (Telonic)		
46	H	Termination TRM-1-1.30F (Telonic)	Termination TRM-1-1.30F (Telonic)		
47	F, H	Termination TRM-1-1.25F (Telonic)	Termination TRM-1-1.25F (Telonic)		
48	F	*Compressor-Limiter, Radio Engineering Labs 23380	*Compressor-Limiter Radio Engineering Labs 23380		
49	H	Compressor-Limiter, Radio Enginner-ing Labs 23380			
50	F	AC/DC VTVM, RCA WV 98C	Substitute Item 42		
51	F	Loop Converter, Radio Engineering Labs S-1638-2			
		*Part of Performance Monitor TYPE 1095A			

MAINTENANCE ALLOCATION CHART

GROUP NUMBER	COMPONENT ASSEMBLY NOMENCLATURE	MAINTENANCE FUNCTIONS											TOOLS AND EQUIPMENT	REMARKS
		INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL	REBUILD		
1	RECEIVER (REL 1130A)	O	F										1, 3, 5, 7, 12 thru 17, 22, 23, 25, 26, 31 thru 35, 41, 44, 51	Visual
					F								1, 3, 5, 7, 12 thru 17, 22,23, 25, 26, 31 thru 36, 41, 44, 51	
										O			36	Replace lamps, knobs & fuses
										F			1, 3, 5, 7, 12 thru 17, 22, 23, 25, 26, 31 thru 36, 41, 44, 51	Restore to serviceable condition

SECTION III - MAINTENANCE ALLOCATION CHART (TYPE 1130A)

MAINTENANCE ALLOCATION CHART

GROUP NUMBER	COMPONENT ASSEMBLY NOMENCLATURE	MAINTENANCE FUNCTIONS											TOOLS AND EQUIPMENT	REMARKS
		INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL	REBUILD		
1A	FREQUENCY CONVERTER (REL 22761)	F												Visual
			F										1, 3, 12 thru 14, 31, 35	
					F								1, 3, 6, 11 thru 14, 18 thru 20, 27 thru 29, 31, 35, 36	
										F			1, 3, 6, 11 thru 14, 18 thru 20, 27 thru 29, 31, 35, 36	
1A1	MIXER (REL 23320)	F												Visual
									H				36	
										D				Return to depot for further disposition
1A2	IF PREAMPLIFIER (REL 23330)	F												Visual
			F										1, 3, 4, 7, 12, 13, 15, 18 thru 20, 31, 34	
					F								1, 3, 4, 7, 12, 13, 15, 18 thru 20, 30, 31, 34, 36	
									F				36, 37	
										D				Return to depot for further disposition

SECTION III - MAINTENANCE ALLOCATION CHART (TYPE 1130A)

MAINTENANCE ALLOCATION CHART

GROUP NUMBER	COMPONENT ASSEMBLY NOMENCLATURE	MAINTENANCE FUNCTIONS											TOOLS AND EQUIPMENT	REMARKS
		INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL	REBUILD		
1A3	SRD MULTIPLIER (REL 24760)	F	H										1 thru 3, 5, 7, 8, 12 thru 14, 25, 26, 35, 38, 39, 42	Visual
					H								1 thru 3, 5, 7, 8, 12 thru 14, 25, 26, 35, 36, 38, 39, 42	
									H	D			36	Return to depot for further disposition
1A4	LOW FREQUENCY AMPLIFIER (REL 22980)	F	H										1 thru 3, 8, 25, 26, 30, 38, 39, 42	Visual
					H								1 thru 3, 8, 25, 26, 30, 36, 38, 39, 42	
									F	H			36, 37	
													1 thru 3, 8, 25, 26, 30, 36, 38, 39, 42	

MAINTENANCE ALLOCATION CHART

GROUP NUMBER	COMPONENT ASSEMBLY NOMENCLATURE	MAINTENANCE FUNCTIONS										TOOLS AND EQUIPMENT	REMARKS
		INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL	REBUILD	
1A5	OSCILLATOR-DOUBLER (REL 24150)	F											Visual
			H										1, 3, 12 thru 14, 38, 39, 42
					H								1, 3, 12 thru 14, 36, 38, 39, 42
									F				36, 37
										H			1, 3, 12 thru 14, 36, 38, 39, 42
1A6	MONITOR CONTROL (REL 23351)	F											Visual
			F										42
									F				36, 37
										D			Return to depot for further disposition
1A7	PRESELECTOR (REL 23340)	F											Visual
			H										12 thru 14, 18 thru 20, 25, 26, 31, 38, 39
					H								12 thru 14, 18 thru 20, 25, 26, 31, 36, 38, 39
									H				36
										D			Return to depot for further disposition

SECTION III - MAINTENANCE ALLOCATION CHART (TYPE 1130A)

MAINTENANCE ALLOCATION CHART

GROUP NUMBER	COMPONENT ASSEMBLY NOMENCLATURE	MAINTENANCE FUNCTIONS											TOOLS AND EQUIPMENT	REMARKS
		INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL	REBUILD		
1B	DEMODULATOR (REL 22772)	O												Visual
			F										5, 7, 9, 10, 12, 13, 18 thru 20, 22, 23, 29, 42	
					F								5, 7, 9, 10, 12, 13, 18 thru 20, 22, 23, 29, 36, 42	
										O				Replace lamps
										F			5, 7, 9, 10, 12, 13, 18 thru 20, 22, 23, 29, 36, 37, 42	Replace defective modules and piece parts
1B1	METER AMPLIFIER AND DETECTOR (REL 23090)	F												Visual
			H										1, 30, 38, 39	
					H								1, 30, 36, 38, 39	
									F				36, 37	
										H			1, 30, 36, 38, 39	
1B2	CHOPPER-DEMODULATOR (REL 23150)	F												Visual
			F										12, 13, 15, 23	
					F								12, 13, 15, 23, 36	
									F				36, 37	
										D				Return to depot for further disposition

MAINTENANCE ALLOCATION CHART

GROUP NUMBER	COMPONENT ASSEMBLY NOMENCLATURE	MAINTENANCE FUNCTIONS											TOOLS AND EQUIPMENT	REMARKS
		INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL	REBUILD		
1B3	IF AMPLIFIER (REL 23360)	F							H	D			36	Visual Return to depot for further disposition
1B4	COMPRESSOR-LIMITER (REL 23380)	F	H										1, 3, 18 thru 20, 27, 28, 30, 38, 39, 42, 44 thru 47	Visual
					H								1, 3, 18 thru 20, 27, 28, 30, 36, 38, 39, 42, 44 thru 47	
									F				36, 37	
										H			1, 3, 18 thru 20, 27, 28, 30, 36, 38, 39, 42, 44 thru 47	
1B5	DRIVER-DISCRIMINATOR (REL 23391)	F	H										12 thru 14, 18 thru 20, 27 thru 30, 38, 39, 42, 49	Visual
					H								12 thru 14, 18 thru 20, 27 thru 30, 36, 38, 39, 42, 49	
									F				36, 37	
										H			12 thru 14, 18 thru 20, 27 thru 30, 36, 38, 39, 42, 49	

SECTION III - MAINTENANCE ALLOCATION CHART (TYPE 1130A)

MAINTENANCE ALLOCATION CHART

GROUP NUMBER	COMPONENT ASSEMBLY NOMENCLATURE	MAINTENANCE FUNCTIONS										TOOLS AND EQUIPMENT	REMARKS
		INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL	REBUILD	
1B6	DRIVER-DISCRIMINATOR (REL 23392)	F	H		H				F	H			12, 13, 18 thru 20, 27, 30, 38, 39, 42, 49 12, 13, 18 thru 20, 27, 30, 36, 38, 39, 42, 49 36, 37 12, 13, 18 thru 20, 27, 30, 36, 38, 39, 42, 49	Visual
1B7	DISTRIBUTION AMPLIFIER (REL 23402)	F	H		H				F	H			21, 24, 38, 39, 42 21, 24, 36, 38, 39, 42 36, 37 21, 24, 36, 38, 39, 42	Visual
1B8	CHANNEL CAPACITY SELECTOR (REL 23492)	F	H		H				F	H			21, 24, 38, 39, 42 21, 24, 36, 38, 39, 42 36, 37 21, 24, 36, 38, 39, 42	Visual

MAINTENANCE ALLOCATION CHART

GROUP NUMBER	COMPONENT ASSEMBLY NOMENCLATURE	MAINTENANCE FUNCTIONS											TOOLS AND EQUIPMENT	REMARKS
		INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL	REBUILD		
1B9	CHANNEL CAPACITY SELECTOR (REL 23495)	F	H										21, 24, 38, 39, 42	Visual
					H								21, 24, 36, 38, 39, 42	
									F	H			36, 37 21, 24, 36, 38, 39, 42	
1B10	COMBINER (REL 23510)	F	H										21, 24, 38, 39, 42	Visual
					H				F	H			21, 24, 36, 38, 39, 42 36, 37 21, 24, 36, 38, 39, 42	
1B11	NOISE AMPLIFIER (REL 23520)	F							F	D			36, 37	Visual Return to depot for further disposition
1B12	NOISE AMPLIFIER (REL 23530)	F							F	D			36, 37	Visual Return to depot for further disposition

MAINTENANCE ALLOCATION CHART

GROUP NUMBER	COMPONENT ASSEMBLY NOMENCLATURE	MAINTENANCE FUNCTIONS										TOOLS AND EQUIPMENT	REMARKS
		INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL	REBUILD	
1B13	PILOT AMPLIFIER (REL 23541)	F	H		H				F	H			21, 24, 38, 39, 42 21, 24, 36, 38, 39, 42 36, 37 21, 24, 36, 38, 39, 42	Visual
1B14	BASEBAND AMPLIFIER (REL 23551)	F	H		H				F	H			21, 24, 38, 39, 42 21, 24, 36, 38, 39, 42 36, 37 21, 24, 36, 38, 39, 42	Visual
1B15	ORDERWIRE AMPLIFIER (REL 23571)	F	H		H				F	H			21, 24, 38, 39, 42 21, 24, 36, 38, 39, 42 36, 37	Visual
1B16	ALARM AMPLIFIER (REL 23582)	F	H						F	H			21, 24, 38, 39, 42 36, 37 21, 24, 36, 38, 39, 42	Visual

MAINTENANCE ALLOCATION CHART

GROUP NUMBER	COMPONENT ASSEMBLY NOMENCLATURE	MAINTENANCE FUNCTIONS											TOOLS AND EQUIPMENT	REMARKS
		INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL	REBUILD		
1B17	REFLEX AND RECORDER AMPLIFIER (REL 23591)	F	H										21, 24, 38, 39, 42, 43	Visual
					H								21, 24, 36, 38, 39, 42, 43	
									F				36, 37	
										H			21, 24, 36, 38, 39, 42, 43	
1B18	MONITOR CONTROL SECTION (REL 23601)	F												Visual
			H										43	
									F				36, 37	
										O			36	
										H			36, 43	
1B19	BANDPASS FILTER (REL FL 5246)	F												Visual
			F										1 thru 3, 12 thru 15	
									F				36, 37	
										D				Return to depot for further disposition
1B20	HIGH PASS FILTER (REL PF 1433)	F												Visual
			F										1 thru 3, 12 thru 15	
									F				36, 37	
										D				Return to depot for further disposition
1B21	HIGHPASS FILTER (REL PF 1434)	F												Visual
			F										1 thru 3, 12 thru 15	
									F				36, 37	
										D				Return to depot for further disposition

MAINTENANCE ALLOCATION CHART

GROUP NUMBER	COMPONENT ASSEMBLY NOMENCLATURE	MAINTENANCE FUNCTIONS											TOOLS AND EQUIPMENT	REMARKS
		INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL	REBUILD		
1B22	IF FILTER (REL 1392)	F												Visual
			F										1 thru 3, 12 thru 15 36, 37	
									F					
										D				Return to depot for further disposition
1B23	IF FILTER (REL PF 1394)	F												Visual
			F										1 thru 3, 12 thru 15 36, 37	
									F					
										D				Return to depot for further disposition
1B24	LOW PASS FILTER (REL PF 1464)	F												Visual
			F										1 thru 3, 12 thru 15 36, 37	
									F					
										D				Return to depot for further disposition
1B25	LOW PASS FILTER (REL PF 1465)	F												Visual
			F										1 thru 3, 12 thru 15 36, 37	
									F					
										D				Return to depot for further disposition
1B26	PILOT FILTER (REL PF 1455)	F												Visual
			F										1 thru 3, 12 thru 15 36, 37	
									F					
										D				Return to depot for further disposition
1B27	RUMBLE FILTER (REL PF 1260)	F												Visual
			F										1 thru 3, 12 thru 15 36, 37	
									F					
										D				Return to depot for further disposition

MAINTENANCE ALLOCATION CHART

GROUP NUMBER	COMPONENT ASSEMBLY NOMENCLATURE	MAINTENANCE FUNCTIONS											TOOLS AND EQUIPMENT	REMARKS
		INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL	REBUILD		
1C	POWER SUPPLY (REL 22731)	O	H										40, 43	Visual
					H								40, 43	
										O			36	Replace lamps, knobs and fuses
										F			36, 37, 43	Replace defective parts and modules
1C1	COMPONENT ASSEMBLY (REL 400248)	F												Visual
			F										43	
									F				36, 37	
										F			36, 37, 43	
1C2	VOLTAGE REGULATOR (REL 23290)	F												Visual
			H										38, 39, 40, 43	
									F				36, 37	
										H			36, 38, 39, 40, 43	
1C3	VOLTAGE REGULATOR (REL 23300)	F												Visual
			H										38, 39, 40, 43	
									F				36, 37	
										H			36, 38, 39, 40, 43	

TABLE I - TOOL AND TEST EQUIPMENT REQUIREMENTS (TYPE 1130A)

TOOL AND TEST EQUIPMENT REQUIREMENTS

TOOLS AND EQUIPMENT	MAINTENANCE CATEGORY	NOMENCLATURE		FEDERAL STOCK NUMBER	TOOL NUMBER
		Recommended in Manual	Available on Site		
1	F, H, D	RF Voltmeter, Boonton Type 91CA	RF Voltmeter, Boonton Electronics 91DA		
2	F, H	Unterminated BNC Adapter, Boonton Electronics 91-6C	Unterminated BNC Adapter, Boonton Electronics 91-6C		
3	F, H, D	50 ohm BNC Adapter, Boonton Electronics 91-8B	50 ohm BNC Adapter, Boonton Electronics 91-8B		
4	F	6 db Attenuator, AB-06N-Microlab	6 db Attenuator, Microlab AB-06N		
5	F, H	10 db RF Attenuator, Microlab AB-10	10 db Attenuator, Microlab AB-10N		
6	F	12 db RF Attenuator, Microlab AB-12			
7	F, H	20 db Attenuator, Microlab AB-20	20 db Attenuator, Microlab AB-20N		
8	F, H	30 db Attenuator, AB-30N	30 db Attenuator, Microwave AB-30N		
9	F	Delay & Linearity Test Receiver, RCA CS-81	Delay & Linearity Test Receiver, RCA CS-81		
10	F	Delay & Linearity Test Transmitter, RCA CS-80	Delay & Linearity Test Transmitter, RCA CS-80		
11	F	Detector, Alfred 1001	Detector, Alfred Electronics 1001		
12	F, H, D	Frequency Counter, Berkeley 7170 with frequency converters 7571, 7572, 7573	Electronic Counter, Hewlett Packard 5245L		
13	F, H, D		Frequency Converter, Hewlett Packard 5253B		
14	F, H, D		Frequency Converter, Hewlett Packard 5254A		
15	F	*Modem, Radio Engineering Labs 22871	*Modem, Radio Engineering Labs 22871		
16	F	*Noise Analyzer, Radio Engineering Labs 22821	*Noise Analyzer, Radio Engineering Labs 22821		
17	F	*Noise Generator, Radio Engineering Labs 22831	*Noise Generator, Radio Engineering Labs 22831		

*Part of Performance Monitor TYPE 1095A

TABLE I- TOOL AND TEST EQUIPMENT REQUIREMENTS (TYPE 1130A)

TOOL AND TEST EQUIPMENT REQUIREMENTS

TOOLS AND EQUIPMENT	MAINTENANCE CATEGORY	NOMENCLATURE		FEDERAL STOCK NUMBER	TOOL NUMBER
		Recommended in Manual	Available on Site		
18	F, H	Oscilloscope, Hewlett Packard 130C	Oscilloscope, Tektronix 561A		
19	F, H		Dual Trace Amplifier, Tektronix 3A72		
20	F, H		Time Base Unit, Tektronix 2B67		
21	H	Test Oscillator, Hewlett Packard 651B-02	Test Oscillator, Hewlett Packard 651B-01		
22	F	*Test Oscillator, Radio Engineering Labs 22800	*Test Oscillator, Radio Engineering Labs 22800		
23	F	*AC VTVM, Radio Engineering Labs 22812	*AC VTVM, Radio Engineering Labs 22812		
24	H		AC VTVM, Hewlett Packard 403B		
25	F, H	Power Meter, Hewlett Packard 431B	Power Meter, Hewlett Packard 431C		
26	F, H	Thermistor Mount, Hewlett Packard 478A	Thermistor Mount, Hewlett Packard 478A		
27	F, H	UHF Sweep Generator, Hewlett Packard H01-692B	UHF Sweep Generator, Hewlett Packard 8690A		
28	F, H		Hewlett Packard 8698A Plug-In		
29	F, H		Hewlett Packard 8692B Plug-In		
30	F, H	VHF Signal Generator, Hewlett Packard 608D	VHF Signal Generator, Hewlett Packard 608D		
31	F, H	UHF Signal Generator, Hewlett Packard 616B/S	UHF Signal Generator, Hewlett Packard 8614A		
32	F	VSWR Indicator, Hewlett Packard 415B	VSWR Indicator, Hewlett Packard 415E		
33	F	Slotted Line, Hewlett Packard 805A			
		*Part of Performance Monitor TYPE 1095A			

TABLE I - TOOL AND TEST EQUIPMENT REQUIREMENTS (TYPE 1130A)

TOOL AND TEST EQUIPMENT REQUIREMENTS

TOOLS AND EQUIPMENT	MAINTENANCE CATEGORY	NOMENCLATURE		FEDERAL STOCK NUMBER	TOOL NUMBER
		Recommended in Manual	Available on Site		
34	F	50 ohm Resistive Termination, Microlab TA-5-MN			
35	F, H	Frequency Meter, Hewlett Packard 536A	Frequency Meter, Hewlett Packard 536A		
36	O, F, H, D		Tool Kit, Radio Technicians		
37	F	Module Extracting Tool (supplied with equipment)	Module Extracting Tool (supplied with equipment)		
38	H, D	Module Tester, Radio Engineering Labs 25280	Module Tester, Radio Engineering Labs 25280		
39	H, D	Adapter Kit, Radio Engineering Labs 27244	Adapter Kit, Radio Engineering Labs 27244		
40	H	Differential Voltmeter, Fluke 803B			
41	F	*Up Converter, Radio Engineering Labs 23942	*Up Converter, Radio Engineering Labs 23942		
42	F, H, D	AC/DC VTVM, Hewlett Packard 410B	AC/DC VTVM, Hewlett Packard 410B		
43	F, H	VOM, Simpson 260	VOM, Simpson 260-5RT		
44	H	VSWR Detector, Telonic TRB-2	VSWR Detector, Telonic TRB-1		
45	H	Termination TRM-1-1.00F (Telonic)	Termination TRM-1-1.00F (Telonic)		
46	H	Termination TRM-1-1.30F (Telonic)	Termination TRM-1-1.30F (Teleonic)		
47	F, H	Termination TRM-1-1.25 (Telonic)	Termincation TRM-1-1.25 (Telonic)		
48	F	NOT USED			
49	H	Compressor-Limiter, Radio Engineering Labs 23380			
50	F	AC/DC VTVM, RCA WV 98C	Substitute Item 42		

*Part of Performance Monitor TYPE 1095A

TABLE I - TOOL AND TEST EQUIPMENT REQUIREMENTS (TYPE 1130A)

TOOL AND TEST EQUIPMENT REQUIREMENTS

TOOLS AND EQUIPMENT	MAINTENANCE CATEGORY	NOMENCLATURE		FEDERAL STOCK NUMBER	TOOL NUMBER
		Recommended in Manual	Available on Site		
51	F	Loop Converter, Radio Engineering Labs S-1638-2			
52	F	NOT USED			

SECTION IV. MAINTENANCE ALLOCATION CHART, PART NO. S1997

MAINTENANCE ALLOCATION CHART

GROUP NUMBER	COMPONENT ASSEMBLY NOMENCLATURE	MAINTENANCE FUNCTIONS											TOOLS AND EQUIPMENT	REMARKS
		INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL	REBUILD		
1	RF PRESELECTOR, PART NO. S1997	F	H		H	H			F	O H			1,2,3,4, 5,6,7 8,9,10,11, 12,13,14 14 14 1 thru 14 6, 9, 10, 15, 16, 17	Visual Replace dial control and dial adapter

TABLE I. TOOL AND TEST EQUIPMENT REQUIREMENTS, PART NO. S1997

TOOL AND TEST EQUIPMENT REQUIREMENTS

TOOLS AND EQUIPMENT	MAINTENANCE CATEGORY	NOMENCLATURE		FEDERAL STOCK NUMBER	TOOL NUMBER
		RECOMMENDED IN MANUAL	AVAILABLE ON SITE		
		S1997 (Continued)			
1	H	POWER METER, HEWLETT-PACKARD 431B	POWER METER, HEWLETT-PACKARD 431C		
2	H	THERMISTOR MOUNT, HEWLETT-PACKARD 478A	THERMISTOR MOUNT, HEWLETT-PACKARD 478A		
3	H	FIXED ATTENUATOR, MICROLAB AB-10N	FIXED ATTENUATOR, MICROLAB AB-10N		
4	H	SIGNAL GENERATOR, HEWLETT-PACKARD 616B/S	SIGNAL GENERATOR, HEWLETT-PACKARD 8614A		
5	H	SLOTTED LINE, HEWLETT-PACKARD 805A	INDICATOR, STANDING WAVE IM-92/U	6625-356-0314	
6	H	50 OHM TERMINATION, MICROLAB TA-5-MN	50 OHM TERMINATION, MICROLAB TA-5-MN		
7	H	VSWR INDICATOR, HEWLETT-PACKARD 415B	VSWR INDICATOR, HEWLETT-PACKARD 415E-01		
8	H	FREQUENCY METER, HEWLETT-PACKARD 536A	FREQUENCY METER, HEWLETT-PACKARD 536A		
9	H	DETECTOR, ALFRED 1001	DETECTOR, ALFRED 1001		
10	H	OSCILLOSCOPE, HEWLETT-PACKARD 130C	OSCILLOSCOPE, TEKTRONIX 561A		
11	H		DUAL TRACE AMPLIFIER, TEKTRONIX 3A72		
12	H		TIME BASE UNIT, TEKTRONIX 2B67		
13	H	SWEEP GENERATOR, HEWLETT-PACKARD H01-692B	SWEEP GENERATOR, ALFRED 631D-S1		
14	O,F,H		TOOL KIT, TECHNICIAN RADIO SITE		
15	H	DIRECTIONAL COUPLER, HEWLETT-PACKARD 752C	DIRECTIONAL COUPLER, HEWLETT-PACKARD 752C		
16	H	FREQUENCY COUNTER, HEWLETT-PACKARD 5245L WITH PLUG-INS 5245B, 5253B	FREQUENCY COUNTER, HEWLETT-PACKARD 5245L WITH PLUG-INS 5254B, 5253B		
17	H	SWEEP GENERATOR, JERROLD 900A	SWEEP GENERATOR, JERROLD 900B		

SECTION V. MAINTENANCE ALLOCATION CHART, PART NO. 1133/1700-1840 MHZ

MAINTENANCE ALLOCATION CHART

GROUP NUMBER	COMPONENT ASSEMBLY NOMENCLATURE	MAINTENANCE FUNCTIONS										TOOLS AND EQUIPMENT	REMARKS
		INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL	REBUILD	
1	TUNNEL DIODE AMPLIFIER, (REL) 1133/1700-1840 MHZ	F											Visual
			F										1 thru 4
					F								1 thru 5
										O			5
										F			1 thru 5
1A	TUNNEL DIODE MODULE, (REL) 24350/1700-1840 MHZ	F											Visual
			H										1 thru 4
					H								1 thru 5
									F				5
										H			1 thru 5

TABLE I. TOOL AND TEST EQUIPMENT REQUIREMENTS, PART NO. 1133/1700-1840 MHZ

TOOL AND TEST EQUIPMENT REQUIREMENTS

TOOLS AND EQUIPMENT	MAINTENANCE CATEGORY	NOMENCLATURE		FEDERAL STOCK NUMBER	TOOL NUMBER
		RECOMMENDED IN MANUAL	AVAILABLE ON SITE		
		1133/1840-1980 MHZ (Continued)			
1	F,H	FREQUENCY METER, HEWLETT-PACKARD 536A	FREQUENCY METER, HEWLETT-PACKARD 536A		
2	F,H	SIGNAL GENERATOR, HEWLETT-PACKARD 616B	SIGNAL GENERATOR, HEWLETT-PACKARD 8614A		
3	F,H	RF VOLTMETER, BOONTON 91CA	RF VOLTMETER, BOONTON 91DA		
4	F,H	50 OHM RESISTIVE TERMINATION, MICROLAB TA-5-MN	50 OHM RESISTIVE TERMINATION, MICROLAB TA-5-MN		
5	O,F,H		TOOL KIT, TECHNICIAN RADIO SITE		

MAINTENANCE ALLOCATION CHART

GROUP NUMBER	COMPONENT ASSEMBLY NOMENCLATURE	MAINTENANCE FUNCTIONS											TOOLS AND EQUIPMENT	REMARKS
		INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL	REBUILD		
1	TUNNEL DIODE AMPLIFIER, (REL) 1133/1840-1980 MHZ	F												Visual
			F										1 thru 4	
					F								1 thru 5	
										O			5	Replace lamp and fuse
										F			1 thru 5	
1A	TUNNEL DIODE MODULE, (REL) 1133/1840-1980 MHZ	F												Visual
			H										1 thru 4	
					H								1 thru 5	
									F				5	
										H			1 thru 5	

TABLE I. TOOL AND TEST EQUIPMENT REQUIREMENTS, PART NO. 1133/1840-1980 MHZ

TOOL AND TEST EQUIPMENT REQUIREMENTS

TOOLS AND EQUIPMENT	MAINTENANCE CATEGORY	NOMENCLATURE		FEDERAL STOCK NUMBER	TOOL NUMBER
		RECOMMENDED IN MANUAL	AVAILABLE ON SITE		
		1133/1840-1980 MHZ (Continued)			
1	F,H	FREQUENCY METER, HEWLETT-PACKARD 536A	FREQUENCY METER, HEWLETT-PACKARD 536A		
2	F,H	SIGNAL GENERATOR, HEWLETT-PACKARD 616B	SIGNAL GENERATOR, HEWLETT-PACKARD 8614A		
3	F,H	RF VOLTMETER, BOONTON 91CA	RF VOLTMETER, BOONTON 91DA		
4	F,H	50-OHM RESISTIVE TERMINATION, MICROLAB TA-5-MN	50-OHM RESISTIVE TERMINATION, MICROLAB TA-5-MN		
5	O,F,H		TOOL KIT, TECHNICIAN RADIO SITE		

SECTION VII. MAINTENANCE ALLOCATION CHART, PART NO. 1133/1980-2120 MHZ

MAINTENANCE ALLOCATION CHART

GROUP NUMBER	COMPONENT ASSEMBLY NOMENCLATURE	MAINTENANCE FUNCTIONS											TOOLS AND EQUIPMENT	REMARKS
		INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL	REBUILD		
1	TUNNEL DIODE AMPLIFIER, (REL) 1133/1980-2120 MHZ	F												Visual
			F										1 thru 4	
					F								1 thru 5	
										O			5	Replace lamp and fuse
										F			1 thru 5	
1A	TUNNEL DIODE MODULE, (REL) 24350/1980-2120 MHZ	F												Visual
			H										1 thru 4	
					H								1 thru 5	
									F				5	
										H			1 thru 5	

TABLE I. TOOL AND TEST EQUIPMENT REQUIREMENTS, PART NO. 1133/1980-2120 MHZ

TOOL AND TEST EQUIPMENT REQUIREMENTS					
TOOLS AND EQUIPMENT	MAINTENANCE CATEGORY	NOMENCLATURE		FEDERAL STOCK NUMBER	TOOL NUMBER
		RECOMMENDED IN MANUAL	AVAILABLE ON SITE		
		1133/1980-2120 MHZ (Continued)			
1	F,H	FREQUENCY METER, HEWLETT-PACKARD 536A	FREQUENCY METER, HEWLETT-PACKARD 536A		
2	F,H	SIGNAL GENERATOR, HEWLETT-PACKARD 616B	SIGNAL GENERATOR, HEWLETT-PACKARD 8614A		
3	F,H	RF VOLTMETER, BOONTON 91CA	RF VOLTMETER, BOONTON 91DA		
4	F,H	50-OHM RESISTIVE TERMINATION, MICROLAB TA-5-MN	50-OHM RESISTIVE TERMINATION, MICROLAB TA-5-MN		
5	O,F,H		TOOL KIT, TECHNICIAN RADIO SITE		

SECTION VIII. MAINTENANCE ALLOCATION CHART, PART NO. 1133/2120-2260 MHZ

MAINTENANCE ALLOCATION CHART

GROUP NUMBER	COMPONENT ASSEMBLY NOMENCLATURE	MAINTENANCE FUNCTIONS											TOOLS AND EQUIPMENT	REMARKS
		INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL	REBUILD		
1	TUNNEL DIODE AMPLIFIER, (REL) 1133/2120-2260 MHZ	F	F		F					O F			1 thru 4 1 thru 5 5 1 thru 5	Visual
1A	TUNNEL DIODE MODULE, (REL) 24350/2120-2260 MHZ	F	H		H				F	H			1 thru 4 1 thru 5 5 1 thru 5	Visual

TABLE I. TOOL AND TEST EQUIPMENT REQUIREMENTS, PART NO. 1133/2120-2260 MHZ

TOOL AND TEST EQUIPMENT REQUIREMENTS					
TOOLS AND EQUIPMENT	MAINTENANCE CATEGORY	NOMENCLATURE		FEDERAL STOCK NUMBER	TOOL NUMBER
		RECOMMENDED IN MANUAL	AVAILABLE ON SITE		
		1133/2120-2260 MHZ (Continued)			
1	F,H	FREQUENCY METER, HEWLETT-PACKARD 536A	FREQUENCY METER, HEWLETT-PACKARD 536A		
2	F,H	SIGNAL GENERATOR, HEWLETT-PACKARD 616B	SIGNAL GENERATOR, HEWLETT-PACKARD 8614A		
3	F,H	RF VOLTMETER, BOONTON 91CA	RF VOLTMETER, BOONTON 91DA		
4	F,H	50-OHM RESISTIVE TERMINATION, MICROLAB TA-5-MN	50-OHM RESISTIVE TERMINATION, MICROLAB TA-5-MN		
5	O,F,H		TOOL KIT, TECHNICIAN RADIO SITE		

SECTION IX. MAINTENANCE ALLOCATION CHART, PART NO. 1133/2260-2400 MHZ

MAINTENANCE ALLOCATION CHART

GROUP NUMBER	COMPONENT ASSEMBLY NOMENCLATURE	MAINTENANCE FUNCTIONS											TOOLS AND EQUIPMENT	REMARKS
		INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL	REBUILD		
1	TUNNEL DIODE AMPLIFIER, (REL) 1133/2260-2400 MHZ	F												Visual
			F										1 thru 4	
					F								1 thru 5	
										O			5	Replace lamp and fuse
										F			1 thru 5	
1A	TUNNEL DIODE MODULE, (REL) 24350/2260-2400 MHZ	F												Visual
			H										1 thru 4	
					H								1 thru 5	
									F				5	
										H			1 thru 5	

TABLE I. TOOL AND TEST EQUIPMENT REQUIREMENTS, PART NO. 1133/2260-2400 MHZ

TOOL AND TEST EQUIPMENT REQUIREMENTS					
TOOLS AND EQUIPMENT	MAINTENANCE CATEGORY	NOMENCLATURE		FEDERAL STOCK NUMBER	TOOL NUMBER
		RECOMMENDED IN MANUAL	AVAILABLE ON SITE		
		1133/2260-2400 MHZ (Continued)			
1	F,H	FREQUENCY METER, HEWLETT-PACKARD 536A	FREQUENCY METER, HEWLETT-PACKARD 536A		
2	F,H	SIGNAL GENERATOR, HEWLETT-PACKARD 616B	SIGNAL GENERATOR, HEWLETT-PACKARD 8614A		
3	F,H	RF VOLTMETER, BOONTON 91CA	RF VOLTMETER, BOONTON 91DA		
4	F,H	50-OHM RESISTIVE TERMINATION, MICROLAB TA-5-MN	50-OHM RESISTIVE TERMINATION, MICROLAB TA-5-MN		
5	O,F,H		TOOL KIT, TECHNICIAN RADIO SITE		

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General, United States Army,
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11-98
11-158
11-302
11-303
11-347
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11-367
11-368
11-377
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29-134
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29-137

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For explanation of abbreviations used, see AR 310-50.

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